

SELECTED
WATER
RESOURCES
ABSTRACTS



VOLUME 3, NUMBER 7
APRIL 1, 1970

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is \$22.00 (domestic), \$27.50 (foreign), single copy price is \$3.00. Certain documents abstracted in this journal can be purchased from the Clearinghouse at the prices indicated in the entry. Prepayment is required.



U.S. Department of Commerce, Springfield, Va., 22151

SELECTED WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

Selected Water Resources Abstracts

Volume 3 Number 7 April 1, 1970

This issue of Selected Water Resources Abstracts contains 100 abstracts of publications from January 1970. The abstracts were selected from a wide variety of sources, including scientific journals, government reports, and books. The abstracts are intended to provide a broad overview of current research and development in water resources management.

Selected Water Resources Abstracts is a monthly publication that provides information on the latest developments in the field of water resources management. It is intended to serve as a valuable reference tool for researchers, managers, and policymakers involved in water resources management.

Selected Water Resources Abstracts is a monthly publication that provides information on the latest developments in the field of water resources management. It is intended to serve as a valuable reference tool for researchers, managers, and policymakers involved in water resources management.



VOLUME 3, NUMBER 7
APRIL 1, 1970

W70-02443 -- W70-02842

SECRETARY

AMERICAN RESOURCES ABSTRACTS

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.



U.S. GOVERNMENT
PRINTING OFFICE: 1934

CONTENTS

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

CONTENTS

FOREWORD iii

SUBJECT FIELDS AND GROUPS

(Use Edge Index on back cover to Locate Subject Fields and Indexes in the journal.)

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

- 06 WATER RESOURCES PLANNING**
Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.
- 07 RESOURCES DATA**
Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.
- 08 ENGINEERING WORKS**
Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.
- 09 MANPOWER, GRANTS, AND FACILITIES**
Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.
- 10 SCIENTIFIC AND TECHNICAL INFORMATION**
Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

PROTON MAGNETIC RESONANCE SPECTRUM OF POLYWATER,

Princeton Univ., N.J. Dept. of Chemistry.
Gregory A. Petsko.

Science, Vol 167, No 3915, p 171, Jan 9, 1970. 1 p, 1 fig, 4 ref.

Descriptors: *Water structure, *Water properties, *Water analysis, *Nuclear magnetic resonance, *Hydrogen bonding, Analytical techniques, Molecular structure.

Identifiers: Proton magnetic resonance, Polywater.

With the aid of a time-average computer, the proton magnetic resonance spectrum of anomalous water (polywater) is obtained. The spectrum consists of a single broad resonance shifted approximately 300 hertz downfield from the resonance of ordinary water. The spectrum observed may be due to a deshielding by the 'ring current' from the delocalized Pi electrons of the oxygen atoms of the sample, combined with a high degree of hydrogen bonding between molecules, although other explanations are possible. This is in agreement with hexagonal ring structure. (Knapp-USGS)
W70-02617

POLYWATER: PROTON NUCLEAR MAGNETIC RESONANCE SPECTRUM,

Battelle Memorial Inst., Columbus, Ohio; and Maryland Univ., College Park, Dept. of Chemstry. Thomas F. Page, Jr., Robert J. Jakobsen, and Elis R. Lippincott.

Science, Vol 167, No 3914, p 51, Jan 1970. 1 p, 2 fig, 7 ref.

Descriptors: *Water structure, *Water properties, *Density, *Nuclear magnetic resonance, Spectroscopy, Infrared radiation, Optical properties, Hydrogen bonding, Molecular structure.

Identifiers: Water polymers, Polywater.

In the presence of water, the resonance of the strongly hydrogen-bonded protons characteristic of polywater appears at 5 parts per million lower applied magnetic field than water. Polywater made by a new method confirms the infrared spectrum reported originally. (Knapp-USGS)
W70-02618

SUPERDENSE WATER ICE,

Toledo Univ., Ohio. Ritter Astrophysical Center. For primary bibliographic entry see Field 02C.

W70-02619

1B. Aqueous Solutions and Suspensions

THERMODYNAMIC MIXING PROPERTIES OF NaCl LIQUIDS,

Harvard Univ., Cambridge, Mass. Dept. of Geological Sciences.

For primary bibliographic entry see Field 02K.
W70-02627

SOLUBILITIES OF NITROGEN, OXYGEN, AND ARGON IN DISTILLED WATER,

Amherst Coll., Mass. Dept. of Physics.

For primary bibliographic entry see Field 02K.
W70-02701

SOLUBILITY OF ATMOSPHERIC OXYGEN IN WATER,

Harvard Univ., Cambridge, Mass. Sanitary Engineering Div.

For primary bibliographic entry see Field 02K.
W70-02702

NEW TABLES FOR OXYGEN SATURATION OF SEAWATER,

Carnegie Inst. of Tech., Pittsburgh, Pa.; and Massachusetts Inst. of Tech., Cambridge. E. J. Green, and D. E. Carritt.

Journal of Marine Research, Vol 25, p 140-147, Feb 1967. 1 fig, 3 tab, 14 ref.

Descriptors: *Solubility, *Dissolved oxygen, *Seawater, *Temperature, Chlorides.

Identifiers: *Chlorinity, Green's equation, Saturated solubility of oxygen.

Currently available tables for the calculation of oxygen saturation values of seawater are discussed. New tables of the oxygen solubility (ml/l and ug-at/l), in seawater from a water-saturated atmosphere of which oxygen is 0.2094 mole fraction, excluding water vapor, have been prepared based on Green's equation by machine computation. The vapor pressure of seawater has been computed by combining the Goff-Gratch formulation for the vapor pressure of pure water with a relationship for the vapor pressure lowering by sea salt derived from the data of Arons and Kientzler. The vapor pressure so derived was combined with the Bunsen coefficient to calculate the saturated solubility of oxygen per liter of seawater as a function of temperature and chlorinity. A nomogram for oxygen solubility in seawater at equilibrium for laboratory use is added. The values determined for fresh water agree well with those of Klots and Benson and those of Montgomery, Thom, and Cockburn. (Rietveld-Vanderbilt)
W70-02704

DETERMINATION OF DISSOLVED OXYGEN BY THE WINKLER METHOD AND THE SOLUBILITY OF OXYGEN IN PURE WATER AND SEA WATER,

Water Pollution Research Lab., Stevenage (England).

For primary bibliographic entry see Field 02K.

W70-02705

NEW MEASUREMENTS OF OXYGEN SOLUBILITY IN PURE AND NATURAL WATER,

Johns Hopkins Univ., Baltimore, Md. Dept. of Oceanography.

For primary bibliographic entry see Field 02K.

W70-02712

02. WATER CYCLE

2A. General

THEORETICAL BASEFLOW CURVES,

Illinois State Water Survey, Urbana. Hydrology Section.

Krishan P. Singh.

ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6905, p 2029-2048, Nov 1969. 20 p, 9 fig, 3 tab, 10 ref, append.

Descriptors: *Base flow, *Surface-groundwater relationships, *Mathematical studies, Groundwater movement, Aquifers, Artesian wells, Streamflow, Evapotranspiration, Hydraulics, Leakage, Recharge.

Identifiers: Base flow curves.

Baseflow curves are obtained by solving a nonlinear partial differential equation of groundwater flow for different boundary conditions. A theoretical basis is provided for differentiating between these curves for shallow and deep aquifers. Various linearized solutions and their limitations and errors are elucidated. Mathematical expressions are derived for the effects of evapotranspiration and leakage loss in substantially reducing the baseflow and rendering the stream influent dry. Upward leakage from an underlying artesian aquifer causes the baseflow to be more sustained and reduces its recession rate. Aquifer recharge of duration T, simulated by a sine function, leads to a baseflow

hydrograph which peaks at 0.75 T and becomes parallel to the no-recharge curve after about 1.5 T. (Knapp-USGS)
W70-02460

INDIRECT EVALUATION OF SOME CHARACTERISTICS OF A HYDROLOGICAL REGIME OF RIVERS UNDER CONDITIONS OF EXCESSIVE MOISTURE (RUSSIAN),

A. M. Komlev.

In: Vodnye Resursy i Vodnoe Khozyaystvo Sibiri (Water Resources and Water Economy of Siberia), Akad Nauk SSSR, Sibirskoye Otdelenie, Geogr Obschchestvo, Novosibirsk, USSR, p 38-46, 1968. 9 p, 2 fig, 1 tab, 9 ref.

Descriptors: *Surface waters, *Hydrologic properties, *Rivers, Meteorology, Vegetation, Bogs, Lakes, Groundwater, Drainage, Forests, Topography, Runoff, River basins, Watersheds (Basins), Geology, Hydrogeology, Underground storage.

Identifiers: *USSR, Siberia, Excessive moisture regimes.

The hydrological characteristics of the Tyumen region of Western Siberia, characterized by excessive moisture and the presence of numerous lakes and bogs, were investigated by evaluating runoff and the distribution and areal extent of lakes, bogs, and forests. These hydrologic characteristics were then analyzed to determine their association, if any, with the coefficients of areal extent of lakes, bogs, and forests. Definite associations exist between these coefficients and the monthly runoffs. (Gabriel-USGS)
W70-02482

DESERTS: THE PROBLEM OF WATER IN ARID LANDS,

London Univ. (England). Inst. of Education.

Martin Simons.

London, Oxford University Press, 1967. 96 p, 40 fig, 46 plates.

Descriptors: *Arid lands, *Water, *Acclimatization, *Water transfer, *Climatology, Desalination, Irrigated lands, Saturated soils, Saline soils, Groundwater, Surface waters, Deserts, Desalination processes, Nuclear power plants, Animal physiology, Plant physiology, Plant morphology, Water shortage, Economic efficiency, Arable land, California, Weather modification, Agriculture.

Identifiers: *Western U.S., *USSR, Africa, Pakistan, India, Israel, Arabia.

The author presents an extensive and well illustrated overview of the problems of arid lands throughout the world. Over a third of the world's land surface is desert or semidesert. The book begins with a brief review of climatic causes and types of arid and semiarid lands of the world. Discussions follow concerning arid lands plants and animals and their morphological and physiological adjustments to the environment. The major part of the book is devoted to discussions of all the possible sources of water known to man that might be used in developing arid lands. Included are explanations of groundwater occurrence and development in many parts of the world. Origins of rivers that flow through arid regions are illustrated with examples from North Africa, Pakistan, India, the Arab States, Israel, South Africa and western U.S. This section closes with a consideration of problems of waterlogging and salinization which occur when irrigation is not combined with adequate drainage. Treatment of water transfer from humid to arid lands is illustrated primarily with examples from California and central USSR. Various processes for desalination of sea water and brackish water and their present and potential applications are reviewed. The author finally raises the question of economic efficiency in committing water developments in arid lands to irrigation rather than to alternative uses such as industrial development. (Crouse-Arizona)
W70-02561

Field 02—WATER CYCLE

Group 2A—General

THE ROLE OF SOLID AND LIQUID PRECIPITATIONS IN RUNOFF FORMATION (RUSSIAN),
Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.
For primary bibliographic entry see Field 02C.
W70-02654

DETERMINATION OF FLOWS FOR UNGAGED STREAMS,

Washington State Univ., Pullman.

Donald L. Bender.

Completion Report, Washington Water Research Center, Sept 1969. 9 p. OWRR Project A-009-WASH.

Descriptors: *Unit hydrograph, *Runoff simulation, *Laboratory watershed, Rainfall-runoff relationships, Catchments.

Identifiers: *Ungaged streams.

An 8-foot by 16-foot laboratory catchment was used as a hydrologic system to test certain relationships between rainfall and runoff. Unit hydrographs were obtained for a variety of catchment conditions and rainfall intensities and durations. A series of curves for each separate set of rainfall and catchment conditions for one-minute unit hydrographs illustrates that the peak of these unit hydrographs increases until the time of equilibrium is reached. After the time to equilibrium the peaks remain constant and for any given catchment condition the maximum peak discharges of the one-minute unit hydrographs are the same regardless of intensity. Also for a given catchment condition with the duration of rainfall greater than the time to equilibrium, the peak discharges of the total time duration unit hydrographs are the same regardless of intensity. Time to peak on the catchment is related linearly to the time to equilibrium. Kinematic wave formulation is used to express the equation of unsteady flow and a digital computer is used to numerically integrate them. Data from the laboratory catchment is used to verify equations.

W70-02748

GENERALIZED ANALYSIS OF SMALL WATERSHED RESPONSES,

California Univ., Davis.

J. Amorocho.

Available from the Clearinghouse as PB-188 908. \$3.00 in paper copy, \$0.65 in microfiche. Technical Completion Report WRC No 133, California Water Resources Center, Nov 1969. 5 p, 5 ref. OWRR Project B-005-CAL.

Descriptors: *Small watersheds, *Surface runoff, *Rainfall-runoff relationships, *Model studies, Storm-runoff, Streamflow, Flood prediction, Snowmelt, Demonstration watersheds, Small watersheds.

Several topics were investigated under the general heading 'Generalized Analysis of Small Watershed Responses.' Each topic resulted in a self-contained report, but jointly they contribute to a better understanding of various statistical and physical aspects of small watershed behavior: (1) The functional series representation for nonlinear physical system was used to develop a method permitting the determination of a nonlinear prediction equation and the nonlinear response functions for hydrologic systems. The method was tested successfully using rainfall and stream flow data of a small California watershed. (2) A method of curve fitting was applied to precipitation data of an array of rain gages in a small California watershed to obtain a functional representation of the time and space distribution of storm rainfall. This method may be used for the establishment of criteria for precipitation network design and for the analysis of watersheds as nonlinear systems with distributed input fields. (3) A simple cascade model of the rainfall-runoff process was developed to test whether the design of more complex mathematical models is justified from the standpoint of runoff prediction. (4) A detailed mathematical model of the physical processes producing snowmelt was

developed. It is suitable for the prediction of net watershed inputs due to the fusion of snowfields, and may be incorporated into a comprehensive watershed model. (5) A study of the accuracy of the prediction of floods of high return period was conducted. It provided expressions for the standard errors of sample estimates of flood magnitudes corresponding to given return periods for normal and double exponential universes.

W70-02763

2B. Precipitation

SUITABILITY OF THE UPPER COLORADO RIVER BASIN FOR PRECIPITATION MANAGEMENT,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

For primary bibliographic entry see Field 03B.

W70-02622

FREQUENCY ANALYSIS OF RAINFALL INTENSITIES FOR CALCUTTA,

All-India Inst. of Hygiene and Public Health, Calcutta; and Calcutta Metropolitan Planning Organization (India).

V. Raman, and M. Bandyopadhyay.

ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 95, No SA6, Paper 6950, p 1013-1030, Dec 1969. 18 p, 10 fig, 9 tab, 7 ref, append.

Descriptors: *Rainfall disposition, *Frequency analysis, *Duration curves, *Depth-area-duration analysis, Rainfall intensity, Probability, Statistical methods, Runoff, Rational formula, Rainfall-runoff relationships, Storm runoff, Storm drains, Drainage engineering.

Identifiers: *Calcutta (India).

Analysis of the point rainfall data in Calcutta, India for 23 yr yields a procedure for arriving at the relationship between the average intensity of excessive rainfall, the corresponding duration the rain continued to fall at the average rate, and the frequency with which these combinations of intensity and duration of such storms occur. Probability methods based on annual maximum events and partial duration series, and mathematical and graphical curve fitting, based on frequency analysis, are employed for developing the relationships. Intensity duration frequency relations are expressed in tabular and graphical forms and as mathematical equations. The various methods do not give exactly identical results, and discretion must be used to choose between them for application in the design of a storm sewer system. No particular method can be considered as the best for rainfall frequency determination. (Knapp-USGS)

W70-02634

SOME EXPERIENCE IN EVALUATION OF ATMOSPHERIC PRECIPITATIONS IN THE MOUNTAINS OF TRANSILIAN ALA TAU (RUSSIAN),

Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.

Ye. P. Mansurova, and I. S. Sosedov.

Gidrofizicheskie Issledovaniya v Gornykh Raionakh Kazakhstana Akad Nauk Kazakhskoi SSR, Trudy Instituta Gidrogeologii i Gidrofiziki, Vol 2, p 3-18, 1969. 6 fig, 6 tab, 14 ref.

Descriptors: *Precipitation (Atmospheric), *Mountains, Moisture content, Humidity, Winds, Instrumentation, Mathematical studies, Analytical techniques, Snow, Evaporation, Hydrologic data, Seasonal, Altitude.

Identifiers: *USSR, Transilian Ala Tau (Kazakh SSR).

The errors in measurements of atmospheric precipitation are analyzed. A method is given for interpolating corrected values of seasonal and annual precipitation. This interpolation is based on an

empirically derived relationship between gaging station altitudes and atmospheric precipitation. (Gabriel-USGS)
W70-02650

RESULTS OF ATMOSPHERIC CIRCULATION STUDIES OVER EUROPE, ASIA, AND THE ARCTIC BY RADAR-METEOR TECHNIQUE (RUSSIAN),

Institute of Experimental Meteorology (USSR).

I. A. Lysenko, B. L. Kashcheyev, K. A. Karimov,

M. K. Nazarenko, and A. D. Orlyansky.

English summary. Izvestiya Akademii Nauk, SSSR, Seriya Fiziki Atmosfery i Okeana, Vol 5, No 9, p 893-902, Sept 1969. 4 fig, 3 tab, 21 ref.

Descriptors: *Atmosphere, *Atmospheric pressure, *Air circulation, *Arctic, *Meteorites, Radar, Winds, Air masses, Anticyclones, Cyclones, Instrumentation, Measurement, Frequency analysis, Wavelengths, Model studies.

Identifiers: *USSR, Atmospheric circulation, Meteorological radar.

The results of synchronous measurements of the wind regime in the meteor zone are given on the basis of observations recorded from September 1965 to February 1966 in Kharkov, Obninsk, Kiev, Frunze Dushanbe, Tomsk, and on Hayes Island. On the basis of these data the cyclonic or anticyclonic character of prevailing air-mass motions in the meteor zone over Europe, Asia, and the Arctic is identified. (Gabriel-USGS)
W70-02655

ATTAINABLE ACCURACY OF LINEAR STATISTICAL FORECASTING AND OPTIMAL DIMENSIONS OF THE PREDICTOR (RUSSIAN),

A. S. Marchenko.

English summary. Izvestiya Akademii Nauk, SSSR, Seriya Fiziki Atmosfery i Okeana, Vol 5, No 9, p 883-892, Sept 1969. 1 tab, 7 ref.

Descriptors: *Forecasting, *Meteorology, *Statistical methods, *Hydrologic aspects, *Sampling, Hydrology, Mathematical studies, Analysis, Parametric hydrology, Equations, Atmosphere, Atmospheric pressure, Air temperature.

Identifiers: Forecasting statistics, Sampling statistics.

Forecast efficiency is investigated by means of the multiple regression equation taking into account the fact that a limited number of observations is used for evaluation of extrapolational parameters. The results are obtained on the assumption that the vector, composed of the predictor and predictant, is distributed normally and that extrapolational parameters are evaluated on the basis of the sampling of independent observations. The expected r.m.s. error is calculated theoretically from independent data, statistic hypotheses on its numerical value are formulated, and criteria for the test of the hypotheses are indicated. It is shown that there exists an optimal predictor dimension guaranteeing highest accuracy of extrapolation. (Gabriel-USGS)
W70-02656

LOCAL MOISTURE AND PRECIPITATION, Nevada University, Reno. Center for Water Resources Research.

Charles K. Stidd.

Desert Research, Institute Preprint Series No 45, Nevada University, July 1968. 39 p, 5 fig, 26 ref, append. OWRR Proj B-008-NEV.

Descriptors: *Precipitation (Atmospheric), *Precipitable water, Evapotranspiration, *Meteorology, Water balance, Hydrologic budget, Climatology, Water resources development, Atmospheric physics, Air masses, Humidity, Hydrologic cycle, Weather.

Identifiers: Local moisture availability.

Snow, Ice, and Frost—Group 2C

Evidence is presented to show that moisture evaporated or transpired from local soils and plants is important to the precipitation process. The evidence includes a seasonal water balance for that portion of the world lying north of 30 deg N Latitude showing a reversal of the hydrologic cycle during the summer half-year, a discussion of annual cycles of precipitation in the United States showing the importance of local moisture to climate, a demonstration of the mechanism by which locally derived moisture can produce an unstable atmosphere leading to shower activity, and a statistically significant verification of an increase in summer rainfall associated with the Columbia Basin Irrigation Project. (Knapp-USGS) W70-02668

2C. Snow, Ice, and Frost

GLACIAL DRAINAGE DIVIDE IN THE SKAGIT VALLEY, WASHINGTON, Geological Survey, Spokane, Wash.
Paul L. Weis.
Geological Survey Research 1969, Professional Paper 650-C, p C71-C74, 1969. 4 p, 4 fig, 1 ref.

Descriptors: *Watersheds (Divides), *Pleistocene epoch, *Glaciation, *Geomorphology, *Washington, Drainage systems, Rivers, Interfluves, Glacial drift, Erosion.
Identifiers: Skagit Valley (Wash), Glacial drainage divide, Pleistocene drainage patterns.

Major valleys in the western part of the North Cascades primitive area have been intensely glaciated and characteristically have U-shaped cross sections, steep walls, flat floors, and relatively gentle gradients. A notable exception is the Skagit Valley, which has a segment about 7 miles long with a steep gradient and the V-shaped cross section characteristic of stream erosion. The valley upstream and downstream from the V-shaped gorge has the typical U-shaped cross section of a glaciated valley. This anomalous section of the Skagit Valley may best be explained by the hypothesis that it was a drainage divide during late Pleistocene time and was occupied by relatively stagnant ice. (Knapp-USGS)
W70-02458

OPEN-CHANNEL SURGE SIMULATION BY DIGITAL COMPUTER, Georgia Inst. of Tech., Atlanta. School of Engineering, and Harza Engineering Co., Chicago, Ill. Dept. of Hydraulics.
For primary bibliographic entry see Field 08B.
W70-02459

RIVER ICE JAMS - A LITERATURE REVIEW, United States Lake Survey, Detroit, Mich.
S. J. Bolsenga.
Corps Eng. Lake Survey Res Rep 5-5, June 1968. 568 p, 35 fig, 430 ref.

Descriptors: *Ice jams, *Rivers, *Reviews, *Bibliographies, *Surveys, Water level fluctuations, Melting, Frazil ice, Freezing, Slush, Ice, Ice breakup, Navigation, Flood control, Flood protection.
Identifiers: River ice jams, Ice floods.

About 400 published studies of river ice jams in many areas of the world were collected, examined, listed, and summarized. Both current and historical information on the ice jam mechanism and methods of prevention and removal are included. Descriptions of ice jam characteristics range from mathematical to narrative treatments. Methods of prevention and removal range from dusting and thermal pollution to the more widely used blasting. Trends in the use of these techniques are discussed. Lack of success in applying prevention and removal techniques is often caused by lack of basic information on ice jam characteristics. The results of this report can be useful in field operations, and

a guideline for future research planning is provided. (Knapp-USGS)
W70-02494

SUPERDENSE WATER ICE, Toledo Univ., Ohio. Ritter Astrophysical Center. A. H. Delsemme, and A. Wenger. Science, Vol 167, No 3914, p 44-45, Jan 1970. 2 p, 1 tab, 10 ref.

Descriptors: *Ice, *Water properties, *Water structure, Freezing, Density, Mechanical properties, Physical properties, Vapor pressure.
Identifiers: Amorphous ice.

A new allotropic form of water ice with a density of 2.32 plus or minus 0.15 grams per cubic centimeter has been observed at very low pressures and for temperatures lower than 100 deg K. It is most likely amorphous. Distilled water was outgassed, weighed, and conducted to an introduction chamber where it vaporized. The residual pressure of the water vapor in the main chamber was maintained at 0.0001 mm-Hg or less. The main chamber was then cut off from the vacuum pump and checked for leaks. Water vapor was introduced through a valve at a selected rate. During condensation, the pressure was maintained at 6 to 8 x 0.001 mm-Hg in the main chamber by controlling the rate of introduction of water vapor. At temperatures near or below 100 deg K, a new form of ice with very high density was produced. It does not seem that polywater, which solidifies at -40 deg C into a glasslike state, can be directly connected with our observations. (Knapp-USGS)
W70-02619

STALACTITE GROWTH BENEATH SEA ICE, Naval Ship Engineering Center, Port Hueneme, Calif. Port Hueneme Div.
Russell A. Paige.
Science, Vol 167, No 3915, p 171-172, Jan 9, 1970. 2 p, 1 fig, 7 ref.

Descriptors: *Sea ice, *Brines, *Freezing, Water chemistry, Density, Density currents, Sea water.
Identifiers: Ice stalactites.

Fresh ice stalactites were observed beneath sea ice in Antarctica. They are hollow, tapering, inverted cones having a base diameter between 10 and 20 centimeters and a tip diameter of 4 to 10 cm extending downward about 100 cm. The stalactites form when dense, chilled brine drains downward from the ice sheet into seawater of normal salinity and near-freezing temperature. (Knapp-USGS)
W70-02620

A METHOD FOR THE DETERMINATION OF SNOW RESOURCES IN A MOUNTAIN BASIN (RUSSIAN), Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.
I. S. Sosedov, and L. N. Filatova.

Gidrofizicheskie Issledovaniya v Gornykh Raionakh Kazakhstana Akad Nauk Kazakhskoi SSR, Trudy Instituta Gidrogeologii i Gidrofiziki, Vol 2, p 19-26, 1969. 4 fig, 2 tab, 8 ref.

Descriptors: *Snow, *Snowmelt, *Mountains, Mapping, Altitude, Slopes, Seasonal, River basins, Watersheds (Basins), Forests, Landslides.
Identifiers: USSR, Alatau.

Water resources from snowmelt were investigated using a statistical method and observational data of snow thicknesses recorded in the Transilian Alatau. Snow water reserves can be predicted on the basis of snow thickness, altitude, and latitude parameters. (Gabriel-USGS)
W70-02649

SEASONAL FREEZING AND ITS HYDROLOGICAL EFFECT UNDER THE CONDITIONS OF

THE NORTHERN SLOPE OF THE TRANSILIAN ALA TAU (RUSSIAN), Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.
V. A. Sazonov, and I. S. Sosedov.
Gidrofizicheskie Issledovaniya v Gornykh Raionakh Kazakhstana Akad Nauk Kazakhskoi SSR, Trudy Instituta Gidrogeologii i Gidrofiziki, Vol 2, p 94-100, 1969. 2 fig, 1 tab, 12 ref.

Descriptors: *Seasonal, *Freezing, *Soils, *Hydrologic properties, *Mountains, Ice, Soil water, Capillary action, Snow, Snow cover, Air temperature, Altitude, Vegetation, River basins.
Identifiers: *USSR, Transilian Ala Tau.

Seasonal regime of soil freezing, as a function of air temperature, altitude and geographical location, was investigated in the Transilian Ala Tau. Seasonal freezing of soil at altitudes of 3,000 to 3,200 m where the seasonal freezing is in contact with permafrost, strongly affects the formation of runoff, floods, and mud streams associated with the floods. The effects of air temperature and snow cover on the depth of freezing are given. (Gabriel-USGS)
W70-02653

THE ROLE OF SOLID AND LIQUID PRECIPITATIONS IN RUNOFF FORMATION (RUSSIAN), Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.
I. S. Sosedov.

Gidrofizicheskie Issledovaniya v Gornykh Raionakh Kazakhstana Akad Nauk Kazakhskoi SSR, Trudy Instituta Gidrogeologii i Gidrofiziki, Vol 2, p 101-109, 1969. 2 fig, 2 tab, 10 ref.

Descriptors: *Precipitation (Atmospheric), *Rain, *Snow, *Runoff, *Surface runoff, Erosion, Water supply, Water balance, Slopes, Seasonal, Mathematical studies, Soil water, Rain gages, Snow cover, Snowmelt, Altitude.
Identifiers: *USSR, Transilian Ala Tau.

Sources of surface runoff were investigated on the basis of a water balance equation in the Transilian Ala Tau region. Evaluation of the effects of altitude, snow cover, geographical location, vegetation, and slope orientation yields coefficients of runoff formed by solid (snow) and liquid (rain) precipitation. (Gabriel-USGS)
W70-02654

SCATTERING AND ATTENUATION OF RADIATION BY WATER-FILMED HAIL (RUSSIAN), M. T. Abshayev, and V. I. Rozenberg. Izvestiya Akademii Nauk, SSSR, Seriya Fiziki Atmosfery i Okeana, Vol 5, No 9, p 973-978, Sept 1969. 6 fig, 10 ref.

Descriptors: *Hail, *Atmosphere, *Radiation, *Attenuation, Clouds, Rain meteorological data, Meteorology, Ice, Mathematical models, Temperature, Water temperature, Films, Wavelengths, Radiosondes.
Identifiers: Radiation scattering.

Attenuation and scattering of radiation from hail was analytically investigated by assuming the temperature of the ice spheres and the water films to be 0 deg C. Several curves show the effect of ice sphere radius and water film thickness on the transversal cross-section of total attenuation and scattering. (Gabriel-USGS)
W70-02659

INVESTIGATION OF SOIL FREEZING, Rhode Island Univ., Kingston. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08E.
W70-02750

Field 02—WATER CYCLE

Group 2D—Evaporation and Transpiration

2D. Evaporation and Transpiration

WATER REQUIREMENTS OF LAWNGRASS,

Nevada Agricultural Experiment Station, Reno; and Agricultural Research Service, Ames, Iowa. Soil and Water Conservation Research Div.

Rhys Tovey, John S. Spencer, and Dean C. Muckel. American Society of Agricultural Engineers, Transactions, Vol 12, No 3, p 356-358, 1969. 4 tab, 2 fig, 8 ref.

Descriptors: *Arid lands, *Lawns, *Water requirements, *Irrigation efficiency, *Evapotranspiration, Semiarid climates, Nevada, Irrigation design, Lysimeters, Evaporation pans, Solar radiation, Estimating equations, Heat budget, Soil moisture, Root zone, Soil-water-plant relationships, Soil moisture meters, Water conservation, Water management (Applied).

Knowledge of lawnglass water requirements is valuable since substantial amounts of water are often used in irrigation in arid and semiarid climates. Measured or estimated evapotranspiration is basic to irrigation system design and proper scheduling of irrigation. The authors report experiments performed near Reno, Nevada, to determine water requirements of lawnglass. The studies were conducted on lysimeters using a mixture of Kentucky Bluegrass, fescues and white clover. Water applied at each irrigation and effluent pumped from the lysimeters were measured. Soil moisture conditions were monitored, evaporation and net radiation measured and evapotranspiration calculated. Data and visual observations from studies continued over three seasons showed that twice weekly irrigations on sandy loam soil and weekly irrigations on loam soil maintained lawnglass with good appearance and healthy root development during the hot part of the growing season. Significant relationships were found between evapotranspiration estimates by the Penman and Olivier methods and measured evapotranspiration from lawnglass. The authors suggest that Blaney-Criddle coefficients may be useful in estimating irrigation requirements for lawnglass in other areas. (Crouse-Arizona)

W70-02562

TOTAL SUMMER EVAPORATION IN THE CENTRAL MOUNTAIN BELT OF TRANSILIAN ALATAU AND THE EFFECT OF SLOPE EXPOSURE ON EVAPORATION (RUSSIAN),

Akademicheskii Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.

I. S. Sosedov, and L. N. Filatova.

Gidrofizicheskie Issledovaniya v Gornykh Raionakh Kazakhstana Akad Nauk Kazakhskoi SSR, Trudy Instituta Gidrogeologii i Gidrofiziki, Vol 2, p 67-80, 1969. 5 fig, 5 tab, 6 ref.

Descriptors: *Evaporation, *Seasonal, *Mountains, *Slopes, Humidity, Infiltration, Soils, Soil physical properties, Fissures (Geology), Runoff, Instrumentation, Sprinkling, Filtration, Altitude, Vegetation, Water balance.

Identifiers: *USSR, Transilian Alatau, Summer evaporation.

Evaporation data recorded in the mountain belt of Transilian Alatau during snow-free and warm periods are analyzed on the basis of soil variation, altitude, vegetation cover, air temperature, and some hydrometeorological parameters. The study suggests the use of a logarithmic formula for the evaluation of the total monthly evaporation. Some relationship is present between the evaporation intensities and air temperatures. (Gabriel-USGS)

W70-02651

THE EFFECT OF THE ADDITION OF HEAT FROM A POWERPLANT ON THE THERMAL

STRUCTURE AND EVAPORATION OF LAKE COLORADO CITY, TEXAS,

Geological Survey, Washington, D.C. Water Resources Div.

G. E. Harbeck, Jr., G. E. Koberg, and G. H. Hughes.

Studies of Evaporation, Geological Survey Professional Paper 272-B, Washington, 1959. 49 p, 11 tab, 21 fig, 16 ref.

Descriptors: *Evaporation, *Lakes, *Heat balance, Thermal powerplants, Cooling, Energy budget, Heat budget, Reservoirs, Temperature, Solar radiation, Mass transfer, Circulation, Water utilization, Climatology, Humidity, Weather data, Vapor pressure, Thermal properties.

Lake Colorado City is used as a source of cooling water for a thermal-electric-powerplant. Evaporation from the lake was determined by the energy-budget method for the period July 1954 to October 1955. Analyses indicate that if no heat had been added by the powerplant, the water-surface temperature would have been only 0.8 deg C lower than that observed. The temperature rise is almost directly proportional to the heat input. The increase in evaporation from Lake Colorado City, when expressed as a volume, is directly proportional to the amount of heat added and is practically independent of reservoir content. The entire lake is being effectively utilized in disposing of heat. Water temperatures in the lower basin of the lake were higher in winter than those in the upper basin of the lake; no appreciable differences were observed in summer. Density differences between the two parts of the lake were very small at all times. A comparison between average lake temperatures and plant intake water temperatures indicates that water is withdrawn from all levels of the lake above the pump intakes. The average withdrawal temperature to be expected, if the amount of heat added by the powerplant is increased, probably will be about equal to the anticipated surface temperature, which can be determined from graphs in the text. (Novotny-Vanderbilt)

W70-02703

MEASUREMENT OF EVAPOTRANSPIRATION IN LOWLAND VEGETATION,

Maynard E. Bates, and Murray F. Buell.

New Jersey Academy of Science, The Bulletin, Vol 14, No 1-2, Spring-Fall 1969, Jan 2, 1970. 12 p. OWRR Project B-006-NJ.

Descriptors: *Evapotranspiration, *Swamp, Evaporation, Phreatophyte, Shrubs, Transpiration. Identifiers: *Pine Forest, *Lowland vegetation, Evapotranspirometer.

Instrumentation is described whereby the evapotranspiration from bog vegetation can be measured under natural conditions. The instrumentation is automatic, measuring the input and output of water of a system necessary to maintain the same water table within as that prevailing outside the system. The system consists of a six foot square tank containing a unit of vegetation sunk into a bog of the same vegetation and monitored by a pumping and measuring station. The latter is connected through an underground pipe to an irrigation system in the bottom of the tank. The specific environment in the New Jersey Pine Barrens for which it is designed is described. The questions concerned with the Pine Barrens vegetation under relations which it is expected to answer are discussed.

W70-02733

2E. Streamflow and Runoff

TRIANGULAR BROAD-CRESTED WEIR,

Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering, and Colorado State Univ., Fort Collins. For primary bibliographic entry see Field 07B.

W70-02449

DATA ERROR EFFECTS IN UNIT HYDROGRAPH DERIVATION,

New South Wales Univ., Sydney (Australia). Dept. of Civil Engineering, and Imperial Coll. of Science and Technology, London (England).

For primary bibliographic entry see Field 07A.
W70-02454

FLUCTUATING PRESSURES IN SPILLWAY STILLING BASINS,

Minnesota Univ., Minneapolis. Dept. of Civil Engineering, and Iowa State Univ., Ames. Dept. of Engineering Mechanics.

For primary bibliographic entry see Field 08B.
W70-02457

URBAN RUNOFF BY ROAD RESEARCH LABORATORY METHOD,

Illinois State Water Survey, Urbana.

For primary bibliographic entry see Field 04C.
W70-02467

AN INVESTIGATION OF FLOODS IN HAWAII THROUGH SEPTEMBER 30, 1968,

Geological Survey, Honolulu, Hawaii.

For primary bibliographic entry see Field 07C.
W70-02471

FLOW BELOW DEEPLY SUBMERGED RECTANGULAR WEIRS,

Alberta Univ., Edmonton. Dept. of Civil Engineering.

N. Rajaratnam, and D. Muralidhar.

J Hydraul Res, Vol 7, No 3, p 355-374, 1969. 20 p, 13 fig, 2 tab, 8 ref.

Descriptors: *Open channel flow, *Weirs, Discharge (Water), Supercritical flow, Critical flow, Turbulent flow, Vortices, Turbulence, Jets. Identifiers: *Submerged flow, *Submerged weirs.

Flow over weirs submerged more than 90% was studied in a laboratory flume. The vena contracta occurs at a distance of about 1.0 t from the weir where t is the tailwater depth above the crest and the coefficient of contraction is about 0.74. Beyond the vena contracta there is a flow development region of length equal to about 2 t. Beyond the end of the potential core, the fully developed flow region has been found to be essentially the same as a half turbulent free jet, with some difference in the growth of the length scale. The length of the eddying region or standing eddy was studied using dimensional analysis and the experimental results. A simple discharge equation was developed to predict the discharge over submerged rectangular weirs when the submergence ratio is greater than about 90%. (Knapp-USGS)
W70-02472

SCALING PROCEDURES FOR MOBILE BED HYDRAULIC MODELS IN TERMS OF SIMILITUDE THEORY,

University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.

For primary bibliographic entry see Field 02J.
W70-02473

AIR ENTRAINMENT BY FLOWING WATER UNDER REDUCED ATMOSPHERIC PRESSURE,

Engineering Labs., Cambridge (England).

A. M. Binnie, and G. P. Sims.

J Hydraul Res, Vol 7, No 3, p 279-299, 1969. 21 p, 10 fig, 16 ref.

Descriptors: *Closed conduit flow, *Air entrainment, *Hydraulic models, Model studies, Aeration, Bubbles, Cavitation, Spillways, Siphons, Pipelines, Water conveyance. Identifiers: Reduced air pressure.

A circular water tank, with a vertical pipe as overflow, and a small siphon-spillway drawing from a

Streamflow and Runoff—Group 2E

reservoir were placed in turn in a decompression chamber. At ambient pressures down to 2 inches Hg absolute, measurements were made of the water and air discharges at various supply levels. The reduction of ambient pressure had two consequences: (1) the air flow was also reduced; (2) the onset of cavitation in the vertical-pipe apparatus was facilitated. In the siphon, cavitation did not occur. In both sets of apparatus the reduction of ambient pressure H had no noticeable effect on the relation between the head and the water discharge, although the air discharge was lessened. (Knapp-USGS)

W70-02474

FLOODS OF JUNE 1, 1967 IN SOUTHWESTERN JACKSON, MISSISSIPPI,
Geological Survey, Jackson, Miss. Water Resources Div.

Kenneth V. Wilson.

Geological Survey Open-file Report, Sept 1968.

Descriptors: *Floods, *Mississippi, *Rainfall intensity, *Urbanization, Discharge (Water), Stage-discharge relations, Hydrographs, Profiles, Mapping, Hydrologic data, Data collections.

Identifiers: Jackson (Miss).

An intense rainfall of 2 to 4 inches on June 1, 1967, most of it falling within 1 hour, caused unusual flooding in southwestern Jackson, Mississippi. The frequency of this rainfall at the U.S. Corps of Engineers Waterways Experiment Station near Clinton exceeded 25 years for periods less than 1 1/2 hours. The frequency flooding of Hardy Creek was greater than 50 years at McDowell Road and dissipated to about 10 years at Terry Road. The frequency of flooding of Cany Creek exceeded once in 50 years at Raymond Road but was only a 10-year flood at Cooper and Terry Roads. Baker Creek, which drains from the extreme western part of Jackson, flooded Spring Ridge Road to considerable depths. The frequency of this flood on Baker Creek was about 17 years. (Knapp-USGS)

INDIRECT EVALUATION OF SOME CHARACTERISTICS OF A HYDROLOGICAL REGIME OF RIVERS UNDER CONDITIONS OF EXCESSIVE MOISTURE (RUSSIAN),
For primary bibliographic entry see Field 02A.

W70-02482

FLOODS IN TRIPLETT CREEK IN VICINITY OF MOREHEAD, KENTUCKY,
Geological Survey, Washington, D.C.

C. H. Hannum.

Geol Surv Hydrologic Investigations Atlas HA-342, 1 sheet, 1969. Text, 7 fig, 1 map, 2 photo, 3 ref.

Descriptors: *Floods, *Kentucky, *Data collections, *Hydrologic data, Mapping, Streamflow, Stage-discharge relations, Flood damage, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.

Identifiers: *Morehead (Ky), Triplett Creek.

Hydrologic data that can be used to evaluate the extent, depth, and frequency of floods of Triplett Creek, Morehead, Kentucky are presented in a 1-sheet hydrological atlas consisting of a map, photographs, profiles, cross sections, graphs, and text. The data are a technical basis for solving flood plain problems and formulating land use regulations to reduce future damages. Areas that would be flooded by 5-, 25, and 50-year floods are shown on a 1:12,000 topographic map. Past floods and recurrence intervals are plotted on graphs. Cross sections and profiles show flood depths at selected locations. (Knapp-USGS)

W70-02498

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, LOGTOWN QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.

K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-395, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.

Identifiers: *Hurricane Camille (1969), Logtown (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Logtown quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U. S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)

W70-02497

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, ENGLISH LOOKOUT QUADRANGLE, LOUISIANA-MISSISSIPPI,
Geological Survey, Washington, D.C.

K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-396, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.

Identifiers: *Hurricane Camille (1969), English Lookout (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the English Lookout quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U. S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over

75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)

W70-02498

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KILN QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.

K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-397, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.

Identifiers: *Hurricane Camille (1969), Kiln (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast

are shown in a series of hydrologic atlases. The Atlas of the Kiln quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U. S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)

W70-02499

FLOODS IN MISSISSIPPI-SEPTEMBER 1965 THROUGH SEPTEMBER 1967,
Geological Survey, Jackson, Miss.

B. E. Wasson.

Mississippi State Board of Water Commissioners Bulletin 69-1, June 1969. 31 p, 8 fig, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Streamflow, *Rainfall, Rainfall-runoff relationships, Hydrologic data, Data collections, Storms, Hurricanes, Rain, Tides, Waves (Water), Winds.

Identifiers: Mississippi floods (1965-1967).

Several locally severe floods occurred in Mississippi in the period September 1965-September 1967. On September 10, 1965, a tidal wave caused by Hurricane Betsy was responsible for much damage along the western half of the Mississippi gulf coast. Extreme floods occurred February 10, 1966, on streams draining between 10 and 200 sq mi in a relatively narrow area of heavy rainfall between Vicksburg and New Albany. General but less severe flooding occurred in the central and southern parts of the State between February 9-17. During the last half of April 1966 two storm periods caused heavy rain in central Mississippi and unusual floods in the southwestern part of the State. The floods of April 13-15, 1967, in southwestern Mississippi were unusual but not as high as the floods of October 4, 1964. On June 1, 1967, a cloudburst rain caused 50-yr or greater floods on small-drainage areas in southwestern Jackson. Another small-area rain caused 50-yr or greater floods on small streams near Hickory Flat on July 9, 1967. Rainfall as great as 13 inches in 24 hr along the Mississippi gulf coast on September 6, 1967, caused no record floods. (Knapp-USGS)

W70-02621

FLOOD PLAIN INFORMATION OF SCAUAQUADA CREEK, IN THE TOWNS OF CHEEKETOWAGA AND LANCASTER, ERIE COUNTY, NEW YORK,

Corps of Engineers, Buffalo, N.Y.

For primary bibliographic entry see Field 04A.

W70-02629

CALCULATION OF SLOPE STABILITY OF RIVERS AND DRAINAGE CANALS (RUSSIAN),
A. F. Pechkurov.
Gidrotehnika i Melioratsiya, No 9, p 61-73, Sept 1969. 7 fig, 4 tab.

Descriptors: *Slope stability, *Slopes, Rivers, Drainage, Canals, River beds, Bogs, Marshes, Mathematical studies, Gravity, Seepage, Friction, Climates, Freezing, Geology, Porosity, Peat, Runoff, Hydraulic properties, Floods, Erosion.

Identifiers: *USSR, Canal bank stability.

Slope stability calculations are based on the ultimate equilibrium of soil surfaces, the behavior of groundwater and streamflow, the structural and molecular cohesion of earth particles under water, and friction. Several slope stability observations were recorded on many rivers and streams of the USSR under various conditions of slope soil moisture and composition. The applicability of porous concrete plates of various thicknesses is demonstrated for improvement of slope stability of rivers and drainage canals. (Gabriel-USGS)

5

Field 02—WATER CYCLE

Group 2E—Streamflow and Runoff

W70-02658

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUADRANGLES, MISSISSIPPI-ALABAMA,
Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 07C.

W70-02660

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BAY ST. LOUIS QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 07C.

W70-02661

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NW QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 07C.

W70-02662

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASS CHRISTIAN QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 07C.

W70-02663

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NORTH-SOUTH QUADRANGLES, MISSISSIPPI,
Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 07C.

W70-02664

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, VIDALIA QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 07C.

W70-02665

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, WAVELAND-GRAND ISLAND PASS QUADRANGLES, MISSISSIPPI,
Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 07C.

W70-02666

FLOOD PLAIN INFORMATION OF CANADAIGUA OUTLET IN THE COUNTIES OF ONTARIO AND WAYNE, NEW YORK.
Corps of Engineers, Buffalo, N.Y.

For primary bibliographic entry see Field 04A.

W70-02667

BIG BLACK RIVER, MISSISSIPPI Comprehensive BASIN STUDY - ANNEX F. GEOLOGY AND WATER RESOURCES,
Geological Survey, Jackson, Miss. Water Resources Div.

B. E. Wasson.

Big Black River Basin Coordinating Committee Rep., Vol 4, Annex F, Apr 1968. 43 p, 13 fig, 4 tab, 33 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Mississippi, Streamflow, Aquifers, Water quality, Water yield, Water wells, Hydrologic data, Data collections, Water resources development.
Identifiers: *Big Black River (Miss.).

Abundant supplies of water of good quality are available in the Big Black River basin, Mississippi.

from either groundwater or surface water sources. For 90% of the time flow in the lower part of the Big Black River below Pickens is not less than 85 cfs. Chemical quality of water in the streams is excellent, except for impairment caused by pollution at several places. Most of the available groundwater is contained in 6 geologic units from 100 to 1,000 ft thick. The aquifers overlap to the extent that a well drilled to the base of fresh water will in most places penetrate two or more aquifers. Well depths range from less than 10 to 2,400 ft. Water suitable for most needs can be obtained from the aquifers available at most localities. Shallow groundwater (less than 200 ft deep) in the basin usually contains about 100 ppm of dissolved solids. Most water in the basin from more than 2,500 ft below land surface contains more than 1,000 ppm of dissolved solids. Practically all water used in the basin is from the ground (about 11 mgd); however, a small amount of surface water is used for supplemental irrigation of row crops. Most of the area is underlain by one or more aquifers from which a properly constructed well could produce as much as 2,000 gpm. All the towns in the area have sufficient groundwater available to at least double or triple their groundwater pumpage. (Knapp-USGS) W70-02672

JETS WITH NEGATIVE BUOYANCY IN HOMOGENEOUS FLUID,

Waterloopkundig Laboratorium, Delft (Netherlands).

Gerrit Abraham.

Journal of Hydraulics Research, Vol 5, No 4, p 235-248, 1967. 1 tab, 3 fig, 9 ref.

Descriptors: *Jets, *Buoyancy.

Identifiers: *Entrainment, Flow pattern.

This study analyzes the flow pattern of a jet issuing vertically upwards into a lighter homogeneous ambient fluid and the decrease of the vertical flux of tracer near the ceiling level is taken into consideration to determine the coordinate of the ceiling level. Only three-dimensional axisymmetrical jets are considered. The author analyzes two zones: (a) zone with positive entrainment, near the orifice and (b) zone with negative entrainment, near the ceiling level, and gives mathematical solutions for both cases. A comparison between previously published theories and experimental data was made. The position of the ceiling level fluctuates with time when making a comparison between the present theory and previously published theories. Also, the present theory gives higher values of the coordinate of ceiling level than found by Morton and by Priestley and Ball. The experiments confirm that the present theory gives the ceiling level when it is high and that the solution of Morton gives the ceiling level when it is low; but both theories are of equal practical significance. The theory of Priestley and Ball gives the ceiling level when it is high, contrary to expectations. (Guerrero-Vanderbilt) W70-02715

CURRENT STUDY IN THE NEUSE RIVER AND ESTUARY OF NORTH CAROLINA,

North Carolina Univ., Morehead City. Inst of Marine Sciences.

For primary bibliographic entry see Field 021.

W70-02760

GENERALIZED ANALYSIS OF SMALL WATERSHED RESPONSES,

California Univ., Davis.

For primary bibliographic entry see Field 02A.

W70-02763

2F. Groundwater

FUTURE OF GROUND WATER IN AFRICAN SAHARA DESERT,

Alexandria Univ. (Egypt). Faculty of Engineering. H. Y. Hammam.

ASCE Proc, J Irrig and Drainage Div, Vol 95, No IR4, Pap 6986, p 563-580, Dec 1969. 18 p, 7 fig, 7 tab, 11 ref, append.

Descriptors: *Water resources development, *Arid lands, Water wells, Pumping, Recharge, Mathematical studies, Water supply, Discharge (Water), Water storage, Irrigation, Irrigation water, Aquifers.

Identifiers: Sahara Desert, Oases.

The two-dimensional problem of unsteady seepage flow through a confined sand bed of vast plan area is attempted on mathematical lines. The treatment is applied to the groundwater reservoir lying under the vast African Sahara Desert with the object of determining the amount of recharge to this aquifer as well as the amount of its storage. The future groundwater discharges of two main oases in Egypt (namely Kharga and Dakhla) have been predicted to the year 2000. The free flow discharge of Kharga Oasis at present can irrigate a cultivated area of about 10,000 acres, the corresponding area of Dakhla Oasis being 22,000 acres. The installation of pumps in Kharga wells increases their discharge by about 15% and those of Dakhla by about 7%. Owing to various complications in the pump installation, and the low water gain obtained by them, pumps should not be used. Their expenses far exceed the water gain. (Knapp-USGS) W70-02452

NONLINEAR FLOW IN POROUS MEDIA BY FINITE ELEMENTS,

Townsville Univ. Coll. (Australia). Dept. of Civil Engineering.

Raymond E. Volker.

ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6927, p 2093-2114, Nov 1969. 22 p, 6 fig, 3 tab, 35 ref, append.

Descriptors: *Groundwater movement, *Mathematical models, Hydraulic models, Piezometry, Dupuit-Forchheimer theory, Numerical analysis, Porous media, Discharge (Water), Equations.

Identifiers: Nonlinear groundwater flow.

Two commonly suggested forms of the equations linking head loss and velocity for flow of water through coarse granular media are the Forchheimer and exponential relations. Combined with the continuity expression, these relations give the differential equations applicable, within the limits of validity of the parent relations, to actual regions of flow. The resultant nonlinear partial differential equations are amenable to solution by the numerical technique known as the method of finite elements. This technique has advantages when dealing with complex boundary shapes. Solutions have been obtained for some examples of unconfined flow with boundary conditions similar to those likely to be encountered in practical applications. Experimental work in an open flume has shown that agreement between observed and calculated values of discharge and piezometric head can be obtained when the coefficients in the head loss equations are accurately known. (Knapp-USGS) W70-02455

THEORETICAL BASEFLOW CURVES,

Illinois State Water Survey, Urbana. Hydrology Section.

For primary bibliographic entry see Field 02A.

W70-02460

NONLINEAR FLOW IN POROUS MEDIA,

Missouri Univ., Rolla. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

Nazeer Ahmed, and Daniel K. Sunada.

ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6883, p 1847-1857, Nov 1969. 11 p, 2 fig, 1 tab, 19 ref, append.

WATER CYCLE—Field 02

Water in Soils—Group 2G

Descriptors: *Saturated flow, *Porous media, *Filtration, *Dimensional analysis, *Groundwater movement, DupuitForchheimer theory, Hydraulics, Turbulence, Convection, Mathematical studies, Reviews.

Identifiers: *Nonlinear flow (Porous media).

Many investigators are concerned about the validity of the Forchheimer equation which represents the relationship between the velocity of flow and pressure gradient in porous media. A theoretical development of this equation through analysis of the dimensionless form of the Navier-Stokes equation is presented. It shows that energy losses at high-flow velocities in porous medium are a result of convective acceleration effects, not turbulent effects. In addition, two dimensionless terms representing the flow behavior are defined and evaluated. It is shown that a constant could be used to represent the geometric properties of the medium and that a characteristic length representative of the flow exists. Both of these quantities are easily evaluated through hydraulic measurements of gradients and flow velocities. Experimental data from many sources were used to evaluate the theoretical results. (Knapp-USGS)
W70-02464

THE INTERPRETATION OF INTERFERENCE TESTS IN NATURALLY FRACTURED RESERVOIRS WITH UNIFORM FRACTURE DISTRIBUTION,
Atlantic Richfield Co., Dallas, Tex.
For primary bibliographic entry see Field 08B.
W70-02469

AN INVESTIGATION OF THE FLOW REGIME FOR HELE-SHAW FLOW,
Shell Development Co., Houston, Tex.; and Purdue Univ., Lafayette, Ind.
For primary bibliographic entry see Field 08B.
W70-02470

UNDERGROUND WATER DEVELOPMENT.
For primary bibliographic entry see Field 06E.
W70-02530

WATER IN THE KAHUKU AREA, OAHU, HAWAII,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 03B.
W70-02623

BASIN TRACER CURVES INTERPRETED BY BASIC ANALYTICS,
Bason and Filter Specialty Co., Shreveport, La.
For primary bibliographic entry see Field 07B.
W70-02633

MEASURING SUBSURFACE SPRING FLOW WITH RADIOTRACERS,
Federal Water Pollution Control Administration, Dallas, Tex.; and Corps of Engineers, Tulsa, Okla. Engineering Div.
For primary bibliographic entry see Field 07B.
W70-02637

FREE WATER FLOW TO ROWS OF WELLS (RUSSIAN),
Cairo Univ. (Egypt).
M. Amer Abdel-Vakhab.
Gidrotekhnika i Melioratsiya, No 9, p 108-115, Sept 1969. 7 fig, 2 tab, 5 ref.

Descriptors: *Groundwater movement, *Water holes, *Water wells, *Mathematical studies, Irrigation wells, Irrigation, Water storage, Hydrogeology, Discharge (Water), Hydraulic models, Piezometry, Hydrodynamics, Water level fluctuations.
Identifiers: *USSR.

Hydrodynamic movement nets of groundwater flow to water wells were analytically investigated and the results were compared with available experimental data. Use of various published formulas give similar results which are comparable with results obtained by the use of experimental data. Variations of gradients, even of considerable magnitudes, do not effect the discharge values of water wells. It is of interest to note that experimental studies using flumes give a correct picture of groundwater movements toward water wells. (Gabriel-USGS)
W70-02657

BIG BLACK RIVER, MISSISSIPPI COMPREHENSIVE BASIN STUDY - ANNEX F. GEOLOGY AND WATER RESOURCES,
Geological Survey, Jackson, Miss. Water Resources Div.

For primary bibliographic entry see Field 02E.
W70-02672

GEOLOGY AND GROUNDWATER RESOURCES OF CASS COUNTY, NORTH DAKOTA: PART 3,
Geological Survey, Bismarck, N. Dak.

Robert L. Klausing.

North Dakota Geological Survey Bull 47 and State Water Commission County Ground Water Studies 8, 1968. 77 p, 24 fig, 2 plate, 2 tab, 29 ref, append.

Descriptors: *Water resources, *Groundwater, *North Dakota, Water wells, Aquifers, Glacial drift, Water quality, Water yield, Hydrologic data, Data collections, Water levels, Hydrogeology, Stratigraphy.
Identifiers: *Cass County (N Dak).

Location and extent of the various sources of groundwater in Cass County, N. Dak. and the chemical quality of the water available from each source are described. The potential of each groundwater source for future development is evaluated. Important sources of groundwater are the sand and gravel deposits in the glacial drift and sand and sandstone beds in the Dakota Sandstone. The West Fargo aquifer, which underlies about 110 sq mi in southeastern Cass County, is the most permeable and productive aquifer in the county. It also is the most heavily pumped aquifer, and water-levels have declined seriously in the West Fargo and surrounding areas. Quality of the groundwater from major drift aquifers differs considerably from place to place. Generally the water is suitable for domestic and stock use, and some of the water is suitable for irrigation. Dissolved-solids concentration from the 7 aquifers ranges from about 380 ppm to about 1,560 ppm. The Cretaceous Dakota Sandstone is the only bedrock unit in the county that is known to yield water to wells. Dakota Sandstone water is highly mineralized and unsuitable for most uses except stock. The water has dissolved-solids concentrations ranging from about 2,600 to about 4,000 ppm. (USGS)
W70-02675

RELATION OF BEDROCK FRACTURE SYSTEMS TO UNDERGROUND WATER SUPPLIES IN THE STAFFORD SPRINGS, SOUTH CONVENTRY, SPRING HILL, AND WESTFORD QUADRANGLES,
Connecticut Univ., Storrs.

Janet M. Aitken.

Available from the Clearinghouse as PB-188 932, \$3.00 in paper copy, \$0.65 in microfiche. Research Project Completion Report, Dec 1969. 7 p, 8 fig, 1 append. OWRR Project A-004-CONN.

Descriptors: *Structural geology, Seismology, *Groundwater movement, Seismic properties, *Connecticut.
Identifiers: Fractures (Geology), Joints (Geology), *Fracture intersections (Geology).

Careful study of joint patterns by photo-interpretation and supplemental detailed field studies in-

dicates that intersections of joints and foliation play an important part in the movement of fluids through bedrock. More importantly, for the area under consideration one can demonstrate that any model based on the concept of a closed system will give an erroneous impression of movement of fluids through bedrock. This is an essential consideration in areas of thin cover and complicated structures. Seismic surveys proved useful in making broad distinctions in types of glacial cover as well as in more common use for determining thicknesses of surface and subsurface layers. The detection of shatter zones by this method is less certain but should be considered as a valid preliminary to more direct methods of exploration such as drilling.
W70-02756

2G. Water in Soils

INFILTRATION OF WATER INTO NONUNIFORM SOIL,

Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Herman Bouwer.

ASCE Proc, J Irrig and Drainage Div, Vol 95, No IR4, Pap 6937, p 451-462, Dec 1969. 12 p, 5 fig, 2 tab, 11 ref, append.

Descriptors: *Infiltration, *Soil water movement, *Irrigation, *Water spreading, Percolation, Runoff, Wetting, Hydraulic conductivity, Mathematical studies, Mathematical models.
Identifiers: Nonuniform soils.

A simplified procedure for calculating infiltration into soil of nonuniform water content or hydraulic conductivity, or both, is presented. The procedure is based on the Green and Ampt model of piston flow. Input data consist of the difference in water content before and after wetting, the hydraulic conductivity after wetting, and the water entry value of the soil. Techniques for measuring these parameters in the field are briefly described. The procedure is applied to calculate infiltration-time relationships for flood irrigation of a coarse-textured and a fine-textured soil, and to evaluate the effect of nonuniform inundation time on irrigation efficiency. The results show that the usual recommendation of allowing an inundation-time difference of not more than 25% of the time required for the desired amount of water to infiltrate into soil can give irrigation efficiencies of 90% or more. Thus, larger differences in inundation time can be allowed in practice, particularly if the hydraulic conductivity of the soil decreases with depth.
W70-02447

ANALYSIS OF INFILTRATION INTO DRAINING POROUS MEDIA,

Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

Frank D. Whisler, and Keith K. Watson.
ASCE Proc, J Irrig and Drainage Div Vol 95, No IR4, Pap 6946, p 481-491, Dec 1969. 11 p, 13 fig, 10 ref, append.

Descriptors: *Infiltration, *Drainage, *Groundwater movement, *Soil water movement, Flooding, Irrigation, Water spreading, Numerical analysis, Saturated flow, Filtration, Hysteresis, Wetting, Drying, Recharge, Sands, Mathematical studies.
Identifiers: Wetting fronts.

Numerical analysis was applied to the inundation of a draining sand column. A method was proposed whereby hysteresis could be considered. For Botany sand, after periods of short drainage between inundations, infiltration is rapid. For longer periods of drainage the ensuing infiltration is slower, but the water moves through the media with a much steeper front. The effects of hysteresis are dynamic, depending upon the stage of drainage and the relationship used. Using a strictly wetting curve gives a better prediction than a strictly draining curve. (Knapp-USGS)
W70-02448

Field 02—WATER CYCLE

Group 2G—Water in Soils

THE EFFECT OF GYPSUM ON THE WATER STORAGE IN A SANDY LOAM SOIL UNDER AN IRRIGATED PERENNIAL PASTURE,

Commonwealth Scientific and Industrial Research Organization, Riverina (Australia). Riverina Lab. B. J. Bridge, and C. R. Kleinig.

International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 1, p 313-323, 1968. 3 tab, 3 fig, 14 ref.

Descriptors: *Gypsum, *Soil moisture, *Irrigation efficiency, *Soil chemical properties, *Hydraulic conductivity, Soil-water-plant relationships, Semiarid climates, Soil physical properties, Clays, Clovers, Productivity, Calcium, Sodium, Magnesium, White clover, On-site investigations, Electrical conductance, Pastures, Cation exchange.
Identifiers: *Australia.

This paper describes an experiment in New South Wales, Australia, to study the effect of gypsum on a red brown soil with 34% clay content in the B horizon and low hydraulic conductivity. A split plot design was used with three replications with treatments of three irrigation frequencies. Gypsum was applied at the rate of 10 metric tons/ha. White clover was grown and harvested as a measure of productivity. Gypsum had no effect on bulk density but it significantly increased soil moisture storage at all levels of irrigation. Hydraulic conductivity of the subsoil was increased, as was exchangeable calcium, while sodium and magnesium were decreased. There was also a significantly increased production of white clover accompanying these soil changes. Average growth rate increased from 18.0 to 43.4 Kg D.M./ha/day. The gypsum produced an increased efficiency in the use of applied irrigation water. (Crouse-Arizona)

W70-02557

FACTORS DETERMINING THE HYDRAULIC CONDUCTIVITY OF RED MEDITERRANEAN SOILS AND DERIVED TYPES,

Water Planning for Israel Ltd., Tel-Aviv.

J. E. Berend, and S. Kary.

International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 1, p 273-282, 1968. 2 tab, 1 fig, 9 ref.

Descriptors: *Hydraulic conductivity, *Sands, *Soil formation, *Water spreading, *Soil structure, Lime, Water table, Recharge, Carbonates, Anaerobic conditions, Citrus fruits, Clays, Soil physical properties, Reclamation, Soil profiles, Pervious soils, Dunes, Aeolian soils, Irrigated land, Agriculture, Arable land, Semiarid climates, Soil types, Leaching, Soil analysis, Percolating water.
Identifiers: *Israel.

This article reports a study of hydraulic characteristics of soils on Israel's northern coastal plain. Although annual rainfall is 450-500 mm, the evaporative potential is approximately 1.1 meter per year. This evaporation and the fact that soils have developed on sand dunes result in soil characteristics and problems similar to those of some semiarid or even arid lands. Silt and clay fractions are mainly aeolian in origin, with a wide range of textual variation. Coarse and medium textured soils are considered excellent for irrigated agriculture including citrus orchards. Aims of the study were to locate pervious soils suitable for water spreading and impervious soils suitable for water storage sites; to determine the hydraulic conductivity profile down to the water table, since impervious layers in the subsoil could interfere with the vertical movement of water; and to predict future changes resulting from various uses. Two main soil types found were: 'Hamra', with excellent physical and chemical properties for agriculture and 'Nazzaz', with very high clay accumulation in the B horizon, causing low conductivity and even anaerobic conditions. A relatively high bivalent cation content resulted in good structure and maintained the hydraulic conductivity. It was concluded that good management of water spreading should replenish the carbonate content and avoid accelerated illuviation. Liming would be essential to reclaiming the pseudogley type such as the Nazzaz soil. (Crouse-Arizona)

W70-02558

SOIL FORMATION AND SALT MIGRATION IN THE MURGAB RIVER DELTA,

Akademiya Nauk SSSR, Moscow. Pochvennyi Institut. N. G. Minashina.

International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 1, p 425-435, 1968. 2 tab, 5 ref.

Descriptors: *Salinity, *Deserts, *Irrigated land, *Soil formation, *Land reclamation, Cultivated lands, Desert plants, Saline water, Irrigation canals, Clay minerals, Sands, Saline soils, Deltas, Soil chemical properties, Groundwater movement, Drying, Irrigation effects.
Identifiers: *USSR, *Kara-Kum Desert, *Murgab River Delta, Oasis.

The Murgab River forms a dry delta in the southeastern Kara-Kum Desert. The alluvium there dates from the middle Quaternary. During the process of drying out of the ancient delta, the soil changed from hydromorphic to a desert phase. While drying the soils became degraded and easily wind-blown. Silt and clay particles were blown away, and sand accumulated. Remaining clay particles helped bind the sand, stabilize the surface and permit establishment of desert vegetation. Under irrigation an oasis soil is formed, depending upon the time span of irrigation, which returns the hydromorphic phase to the soils. In some areas irrigation has been practiced for thousands of years and oasis soils have attained a depth of 3 to 4 m. The old areas plus newer lands have been brought under cultivation with irrigation from the Kara-Kum canal. The source of water, hence the main source of salt, is the Murgab. Part of the soluble salts flow out with groundwater to surrounding desert lands. The salts accumulate in soils, depressions and groundwater of these surrounding regions. The upper 10 to 13 m of soil and groundwater strata were found to be an area of active salt migration. Thus, storage of salts must be carefully considered before reclamation is undertaken of any additional land around the Murgab Oasis. (Crouse-Arizona)

W70-02565

FILTRATION PROPERTIES OF THE SOIL OF THE MOUNTAINS ON THE NORTHERN SLOPE OF TRANSILIAN ALA TAU (RUSSIAN),

Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.

V. A. Sozonov, and I. S. Sosedov.

Gidrofizicheskie Issledovaniya v Gornykh Raionakh Kazakhstana Akad Nauk Kazakhskoi SSR, Trudy Instituta Gidrogeologii i Gidrofiziki, Vol 2, p 81-93, 1969. 3 fig, 2 tab, 12 ref.

Descriptors: *Filtration, *Soil physical properties, *Soils, *Soil water movement, *Slopes, Mountains, Groundwater, Runoff, Floods, Sprinkling, Geology, Vegetation, Altitude, Forests.
Identifiers: *USSR, Transilian Ala Tau, Soil filtration properties.

Filtration intensities, filtration coefficients and the effects of altitude and vegetation on the filtration in soils were investigated in the Transilian Ala Tau. The effects of these parameters on the filtration properties of the Ala Tau soils are given as the coefficients of filtration versus time and versus altitude and soil composition. (Gabriel-USGS)

W70-02652

DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE SIMULATION OF FLAT-LAND WATERSHED HYDRAULICS,

Iowa State Water Resources Research Inst., Ames.

Darrell W. Deboer, and Howard P. Johnson.

Doctoral Thesis, Available from the Clearinghouse as PB-188 793, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, Iowa State Water Resources Research Institute, Nov 1, 1969. 255 p, 17 tab, 66 fig, 105 ref, 13 append. OWRR Project A-024-IA.

Descriptors: *Mathematical model, Watershed hydraulics, Drainage, Iowa, *Subsurface drainage, *Drainage effects, *Simulation, Hydrologic model, Drainage systems.

Identifiers: *Artificial drainage.

Many acres of midwestern agricultural lands have artificial drainage. The primary reason for artificial drainage is to accelerate the removal of excess water from the soil surface (surface drainage) and the crop root zone (subsurface drainage). The hydraulics and hydrology of excess water removal from agricultural lands by artificial means is not well understood. The primary objective was to develop and test a mathematical watershed model which could reflect the effect of artificial drainage and hydrologic parameter variations on watershed hydrographs. A hydrologic mathematical watershed model was developed for the most recently glaciated region of Iowa. The region is characterized by a flat topography, numerous shallow depressional areas commonly called 'potholes', and surface and subsurface drainage systems. The research effort was based on a previously developed hydraulic mathematical watershed model which simulated the movement of excess water from the depressional areas to the watershed outlet. The hydraulic model used excess water as input to simulate watershed hydrographs. The developed hydrologic model uses precipitation as input and simulates the hydrologic watershed processes of infiltration, surface runoff to depressional areas, soil moisture profile storage, evapotranspiration and percolation of water to the water table. The model simulates the hydrology of a watershed from precipitation input to a watershed outflow hydrograph on an individual storm basis. The model was used to simulate five individual hydrologic events for the 24 square mile East Fork Hardin Creek Watershed, Green County, Iowa. The model simulated hydrographs corresponded in shape with field measured outflow hydrographs. The peak discharge deviation between simulated and actual hydrographs varied from -8 to 29 percent with an 8 percent mean deviation.

W70-02676

WATER REPELLENT SOILS: A WORLDWIDE CONCERN IN MANAGEMENT OF SOIL AND VEGETATION,

Forest Service, (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.

For primary bibliographic entry see Field 04A.

W70-02686

SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL,

New Mexico State Univ., University Park.

Harold E. Dregne, and Peter J. Wierenga.

Project Completion Report, Aug 31, 1969. 3 p.

OWRR Project C-1361.

Descriptors: *Salts, *Saline soils, *Water quality, Lysimeters, Leaching, Soil-water movement, Hydraulic conductivity.

Identifiers: *Salinity sensors.

Lysimeters five feet high and 2.5 feet in diameter have been instrumented with tensiometers, suction cups, salinity sensors and thermocouples, with provision for automatic data recording. A constant suction was maintained at the bottom of the lysimeters. Upon irrigation of the columns drainage rates remained at a high level for several days. Average drainage rates were 0.74 mm/day, 0.26 mm/day and 0.12 mm/day, respectively, at 25, 50 and 75 after irrigation with no evaporation from the soil surface. Since the salt concentration of the drainage water was relatively high, this indicates that appreciable salt is moved down the soil profile under unsaturated soil water conditions.

W70-02729

DYNAMIC BEHAVIOR OF SOIL,

Rhode Island Univ., Kingston. Dept. of Civil Engineering; and Rhode Island Univ., Kingston. Dept. of Ocean Engineering.

For primary bibliographic entry see Field 08E.
W70-02751

GROUND WATER SEEPAGE PATTERNS TO WELLS FOR UNCONFINED FLOW, Iowa State Univ, Ames. Dept. of Agronomy.

Don Kirkham.

Available from the Clearinghouse as PB-188 910, \$3.00 in paper copy, \$0.65 in microfiche. Iowa State Water Resources Research Institute, Completion Report, Dec 1969. 9 p, 1 tab, 3 fig. OWRR Project B-002-IA.

Descriptors: *Dupuit-Forchheimer theory, *Flow nets, *Theoretical analysis, Groundwater, Free surfaces, Seepage, Wells, Piezometry, Computer programs.

Dupuit-Forchheimer theory for free surfaces of semi-confined flow has been theoretically investigated as to why the theory fails to predict free surfaces near an outflow sink. It is shown that the theory does indeed give correct free surfaces if the flow medium is of infinite conductivity in the vertical seepage direction as compared with the horizontal. The theory gives non-orthogonal flow nets and examples have been worked out. In another aspect of the research, analytical theory has been developed and digitally computerized to give the free surface for dam seepage; the theory can be modified for well seepage. The present analytical theory needs further development.

W70-02759

2H. Lakes

DENSITY STRATIFIED LAKES IN NORTHERN ELLESMORE ISLAND,

Defence Research Establishment Ottawa, Ontario; and Smithsonian Institution, Washington, D.C. Radiation Biology Lab.

G. Hattersley-Smith, J. E. Keys, H. Serson, and James E. Mielke.

Nature, Vol 225, No 5227, p 55-56, Jan 3, 1970. 2 p, 2 fig, 1 tab, 9 ref.

Descriptors: *Lakes, *Arctic, *Cold regions, *Density stratification, Salinity, Mixing, Diffusion, Sea water.

Identifiers: *Ellesmere Island, Canada.

Lake Tugborg, northern Ellesmere Island (lat 80 deg 50 min N, long 79 deg W) was found to have density stratification. Other lakes in the area show the same phenomenon. All the lakes were formed by isolation of arms of fjords by glacial advances or relative sea-level changes. The lakes are nearly fresh in the upper 5-10 m, and below this depth salinity increases to the bottom. The saline water is probably trapped old sea water. Inflowing fresh water has replaced surface sea water. The stratification is highly stable and is controlled almost entirely by salinity, with temperature playing only a minor part. (Knapp-USGS)

W70-02446

SOME EXPERIENCE IN THE STUDY OF THE DYNAMICS OF A BENTHONIC WATER LAYER IN THE NEAR-SHORE ZONE OF RESERVOIRS (RUSSIAN),

V. G. Bybka.

In: Vodnye Resursy i Vodnoe Khozaystvo Sibiri (Water Resources and Water Economy of Siberia), Akad Nauk SSSR, Sibirskoye Otdelenie, Geogr Obschestvo, Novosibirsk, USSR, p 95-101, 1968. 7 p, 2 fig, 5 ref.

Descriptors: *Reservoirs, *Hydrodynamics, *Water levels, *Shores, *Zoning, Turbulence, Topography, Slope stability, Waves (water), Streamflow, Water pressure, Sedimentation, Erosion.

Identifiers: *USSR, Shore-zone reservoir dynamics.

The dynamics of benthonic water layers was investigated on the basis of laboratory and experi-

mental data recorded at the Novosibirsk water reservoir. The distribution and variations in the near-bottom pressures and the transfer of water and sediment load in the near-bottom layers are intimately associated with the degree of deformation of surface waves and with the shore relief. The positive pressures are characterized by their absolute values and the negative pressures are characterized by their considerable duration lengths. The erosion and transfer of material in an erosion zone is due to the presence of a wave whose duration activity is comparable with that of an inverse flow. (Gabriel-USGS)

W70-02483

THE IMPORTANCE OF PROTOZOA IN CONTROLLING THE ABUNDANCE OF PLANKTONIC ALGAE IN LAKES,

Freshwater Biological Association, Ambleside (England).

Hilda M. Canter, and J. W. G. Lund.

Proceedings of the Linnean Society of London, Vol 179, No 2, p 203-219, June 1968. 4 fig, 2 tab, 4 plates, 24 ref, appendix.

Descriptors: *Protozoa, *Lakes, *Grazing, *Herbivores, *Algae, *Chlorophyta, Food chains, Food webs, Parasitism, Ecology, Aquatic productivity, Plankton, Life cycles, Productivity, Phytoplankton. Identifiers: *Algal control, English Lake District, Esthwaite Water, Lake Windermere, Blelham Tarn, Eudorina elegans, Dictyosphaerium pulchellum, Coenococcus planctonicus, Gemellicystis imperfecta, Paulschulzia tenera, Paulschulzia pseudovolvox, Sphaerocystis schroeteri, Pseudosphaerocystis lacustris, Pseudosphaerocystis neglecta, Pseudosphaerocystis lundii, Synura, Pseudospora, Heliozoa.

Protozoa are described of the genus Pseudospora, which feed on and destroy the colonial flagellate algae, Eudorina elegans and Synura sp, and the colonial green mucilage-embedded algae, Dictyosphaerium pulchellum, Coenococcus planctonicus (Eutetramorus lundii), Gemellicystis imperfecta (Pseudosphaerocystis lacustris, P. neglecta, P. lundii), Paulschulzia tenera (P pseudovolvox), and Sphaerocystis schroeteri (sensu lato). These grazing herbivores, and others known from previous studies, may be important ecological agents in relationships between primary and secondary production. In waters of the English Lake District, the planktonic mucilage-embedded green algae populations were, for the first time, shown to be decimated in short periods following the appearance of a few of the appropriate protozoa within their colonies. As algal numbers decreased, the percentage of algal colonies containing protozoa increased. Infestations occurred primarily during spring and summer when colonial green algae were most common. Results of experiments with laboratory cultures suggested a high degree of specificity of Pseudospora sp for host algae despite close morphological relationships among the algae. The protozoa were described in some detail as to life cycle: free swimming, feeding amoeboid, and encysted stages; and as to peculiarities in method of attack on algae. (Gerhold-Wisconsin)

W70-02500

REPORT ON THE NUTRIENT SOURCES OF LAKE MENDOTA,

Wisconsin Univ., Madison.

For primary bibliographic entry see Field 05B.

W70-02506

FRESHWATER PRIMARY PRODUCTION BY A BLUE-GREEN ALGA OF BACTERIAL SIZE, Nature Conservancy, Edinburgh (Scotland); Freshwater Biological Association, Ambleside, (England).

A. E. Bailey-Watts, M. E. Bindloss, and J. H. Belcher.

Nature, Vol 220, No 5174, p 1344-1345, Dec 1968. 3 fig, 12 ref.

Descriptors: *Fresh water, *Primary productivity, *Cyanophyta, *Nannoplankton, *Size, Photosynthesis, Lakes, Depth, Ecology, Phytoplankton, Distribution, Diatoms, Seasonal, Chlorophyll, Eutrophication, Trout, Cultures, Metabolism, Growth rates, Electron microscopy, Biomass, Aquatic microorganisms, Spectrophotometry, Chlorophylla.

Identifiers: Morphology, Abundance, Synechococcus, Loch Leven (Scotland), Euphotic zone, Algal blooms, Extracellular substances, Scotland, Kinross (Scotland), Winkler technique, Chlorophyceae, International Biological Program, Phase contrast microscopy, Microtubules, Photosynthetic lamellae, Chlorophyll a.

Minute rod-shaped organisms, occasionally present in almost pure stands, colored green a shallow freshwater lake in Scotland. Authors studied its morphology, temporal abundance, and spatial distribution, and measured gross photosynthetic production to determine whether it is a bacterium or cyanophyte (blue-green alga). It was culture studied with light microscopy (transmitted light or phase contrast illumination) and with electron microscopy. Microanatomy showed conclusively that it is a cyanophyte of bacterial proportions, with cylindrical bundles of microtubules at end of each cell, a feature apparently previously unrecorded in cyanophytes. It is apparently an undescribed species of the genus Synechococcus. The phytoplankton standing crop was estimated regularly; gross photosynthetic production measured fortnightly. Present in small amounts throughout winter, numbers of Synechococcus gradually rise beginning in late April, and in June and July, account for over 90% of the estimated total live crop volume. Evidence suggests that, with increasing eutrophication of the loch, blooms have become more common and persistent, those composed of cyanophytes being associated with poor fishing. Whether this species forms part of those blooms is unknown, since untrained observers might easily have mistaken it for a bacterium. (Jones-Wisconsin)

W70-02508

MODERN HYDROCARBONS IN TWO WISCONSIN LAKES,

Princeton Univ., N.J. Dept. of Geology; and Shell Oil Co., Houston, Tex. Technical Services Div.

Sheldon Judson, and Raymond C. Murray.

Bulletin of the American Association of Petroleum Geologists, Vol 40, No 4, p 747-750, Apr 1956. 1 fig, 5 ref.

Descriptors: *Lakes, *Wisconsin, Carbon radioisotopes, Sediments, Diagenesis, Organic matter, Chemical analysis, Oxygenation, Oxidation, Eutrophication, Oligotrophy.

Identifiers: *Hydrocarbons, Lake Mendota (Wis), Trout Lake (Wis), Carbon-14, Chemical processes, Sludge-marl sediments, Gytja, Hydrocarbons (Dead), Hydrocarbons (Modern).

The content of radiocarbon (carbon-14) was determined in bottom sediments of two large Wisconsin lakes: eutrophic Lake Mendota, located in the southern part of the state, and oligotrophic Trout Lake, located near the Michigan boundary. The black sludge-buff marl sediment of Lake Mendota averaged 11% of organic matter and 232 ppm (parts per million) of hydrocarbon; the olive green gyttja of Trout Lake contains about 45% of organic matter and only 277 ppm of hydrocarbon. This discrepancy is attributed to the difference in the nature of organic matter and the level of oxygenation. In contrast with highly oxidizing conditions of Trout Lake, the deficiency of oxygen in Lake Mendota precludes the destruction of hydrocarbons. The radiocarbon activity, detected in sediments of both lakes, indicated that these compounds are of recent origin and not 'dead' constituents of contamination. (Wilde-Wisconsin)

W70-02509

Field 02—WATER CYCLE

Group 2H—Lakes

INTERRELATIONS OF DISSOLVED ORGANIC MATTER AND PHYTOPLANKTON.
Michigan Univ., Ann Arbor. Dept of Zoology.
For primary bibliographic entry see Field 05C.
W70-02510

A LIMNOLOGICAL COMPARISON OF TWELVE LARGE LAKES IN NORTHERN SASKATCHEWAN,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
D. S. Rawson.
Limnology and Oceanography, Vol 5, p 195-211,
1960. 1 fig, 4 tab, 28 ref.

Descriptors: *Limnology, *Lakes, Benthic fauna, Oligotrophy, Precambrian eras, Eutrophication, Productivity, Temperature, Stratification, Dissolved oxygen, Bottom sediments, Hypolimnion, Hydrogen ion concentration, Dissolved solids, Oligochaetes, Light penetration, Color, Plankton, Lake morphology, Amphipoda, Cisco, Trout, Pikes, Suckers, Diatoms, Copepods, Chlorophyta, Cyanophyta, Biomass, Sampling.

Identifiers: *Saskatchewan (Canada), Canada, Morphometric data, Mineral content, Mesotrophy, Chironomids, Sphaeriids, Mysis, Pontoporeia, Pickerel, Botul, Edaphic factors.

Biomasses in 12 large lakes of northern Saskatchewan vary greatly. Five eutrophic lakes on glacial drift have standing plankton crops, bottom organisms, and fish, several times greater than five oligotrophic lakes on Precambrian Shield. Lakes straddling the margin of the Shield are mesotrophic. Underlying reasons for oligotrophy in Shield lakes and increasing eutrophy in more southerly lakes may be edaphic. Since most northern lakes are deep, and most south of the Shield are shallow, this morphometric difference accentuates edaphic influences. Climate also may contribute to differences in biological production. Comparisons between individual lakes of the Precambrian group suggest that morphometric conditions in this group are perhaps less effective than edaphic, particularly in unique Frobisher Lake. Comparisons of five lakes on the glacial drift suggest that continuous mixing of eutrophic Big Peter Pond increases productivity, while rapid flushing of Ile a la Crosse results in markedly decreased production. Eight characteristics—three biological and five physical—appear useful in classifying these lakes. Ranking each lake with respect to these quantified characteristics and comparing summed values may be useful, especially in connection with fish management. (Jones-Wisconsin) W70-02511

MOUNTAIN AND DESERT LAKES IN SOUTHERN KAZAKHSTAN, THEIR RESOURCES AND METHODS OF ECONOMIC DEVELOPMENT,
G. M. Muravlev.

Translated from Akademii Nauk Kazakhskoi SSR, *Vestnik*, p 38-45, Oct 1967. JPRS Translation 45063, April 1968. 12 p.

Descriptors: *Lakes, *Arid lands, *Multiple purpose, *Natural resources, *Resource development, Geologic formations, Geology, Phreatophytes, Surface waters, Groundwater, Mineral water, Fresh water, Fish management, Economics, Mountains, Structural geology.
Identifiers: *USSR, *Kazakhstan.

The author presents a broad coverage of literature on geologic history and structure and on resources of numerous lakes of Southern Kazakhstan, USSR, together with a discussion of implications regarding resources and their economic development. He divides them broadly into mountain fresh water lakes and desert lakes of a generally shallow nature, with either fresh or mineralized water. The mountain lakes are supplied by surface waters of brooks and rivers and groundwaters of local origin. Glacial melt becomes important at higher elevations. The desert lakes have the same basic sources but from mountains rather than local runoff, which is

negligible. Resources of these high quality, freshwater mountain lakes are limited to few fish and recreation potential as yet unrealized because of inadequate roads. The desert lakes are relatively rich in resources: abundant fish and crustaceans, moisture-loving plants, many shore animals such as muskrats, fresh or mineralized water, mineral bottoms, coastal deposits, recreation potential and a potential for growing valuable water plants such as rice. However, the resources may be unstable owing to climatic and water fluctuations. The author proposes that potential economic value of these lakes can only be realized in full through planned long term management: procedures such as structures to stabilize the water level and replacing 'trash' fish with valuable commercial species. (Crouse-Arizona) W70-02564

NUTRIENT LIMITATION OF SUMMER PHYTOPLANKTON GROWTH IN CAYUGA LAKE,
Cornell Univ., Ithaca, N.Y.
For primary bibliographic entry see Field 05C.
W70-02643

LAKE TYPES AND LAKE SEDIMENTS,
Copenhagen Univ. (Denmark). Geographical Lab.
Kaj Hansen.
Verh Internat Verein Limnol, Vol 14, p 285-290,
July 1961. 2 fig, 2 tab, 6 ref.

Descriptors: *Lakes, *Lake soils, Eutrophication, Oligotropy, Dystrophy, Diatoms, Sediments, Calcium carbonate, Peat, Diagenesis.

Identifiers: *Lake typology, Rations (Carbon/Nitrogen), Polyhumous sediments, Silicon dioxide, Tyropeal, Dy, Gytta, Oligohumous sediments, Denmark, Sweden, Ortho-eutrophic lakes, Para-eutrophic lakes, Ortho-oligotrophic lakes, Para-oligotrophic lakes.

Lake sediments with C/N (carbon-to-nitrogen) ratio of 10 or less should be classified as gytta, whereas those of higher ratio as dy. With an increase in the content of acid humus and C/N ratio, the dy changes to tyropeal, as the initial phase of peat formation. The suggested classification of lake sediments is based on two ordinates. The Y axis of C/N ratios from 0 to 20 delineates the oligohumous or gytta sediments from the polyhumous sediments of dy and tyropeal types. The X axis expresses 0 to 100% contents of calcium carbonate plus alkali soluble silicon dioxide of diatom frustules. The gytta of oligohumous oligotrophic lakes originates chiefly from the benthos vegetation and consists in a large part of mineral matter; the gytta of eutrophic lakes is predominantly of planktonic nature. The paper stresses shortcomings of previous classifications by Thienemann (*Die Binnengewässer Mitteleuropas. Binnengewässer I*, Stuttgart, 1925), Naumann (*Grundzüge der regionalen Limnologie. Binnengewässer II*, Stuttgart 1932) and Berg (Berg K. and Petersen, I. C. Studies on the Humic Acid, Lake Gribo. *Folia Limnol. Scand.* No. 8, 1956). (Wilde-Wisconsin) W70-02683

THE SUCCESSION OF 'BLOOM' SPECIES OF BLUE-GREEN ALGAE AND SOME CAUSAL FACTORS,
Saskatchewan Univ., Saskatoon.
U. T. Hammer.

Verh Internat Verein-Limnol, Vol 15, p 829-836,
Feb 1964. 3 fig, 1 tab, 5 ref.

Descriptors: *Cyanophyta, *Environmental effects, *Succession, Ecology, Lakes, Distribution, Temperature, Salinity, Phosphates, Sampling, Semiarid climates, Precipitation (Atmospheric), Ice, Chemical analysis, Scum, Seasonal, Physiological ecology, Water pollution effects, Eutrophication, Cycling nutrients, Nutrient requirements, Calcium, Magnesium, Sodium, Carbonates, Sulfates.
Identifiers: *Bloom species, Saskatchewan (Canada), Hudson Bay (Canada).

Orthophosphates, Physical analysis, Species interactions, *Anabaena flos-aquae*, *Aphanizomenon flos-aquae*, *Lyngbya birgei*, *Microcystis aeruginosa*, *Oscillatoria prolifica*, *Oscillatoria rubescens*.

Results are reported of investigations of ecological relationships of planktonic cyanophytes (blue-green algae), primarily those species which formed water blooms. Twenty-three lakes in southern Saskatchewan, Canada, were periodically examined during periods of 1-3 years. Distribution and bloom production of some of these species with respect to water salinity and temperature, orthophosphate concentration, and species interaction are discussed. Lake waters sampled varied from fresh water to extremely saline. Five freshwater lakes are of the carbonate type, while the others are sulphate lakes; none can be classified as chloride types. The bloom-producing species found were *Anabaena flos-aquae*, *Aphanizomenon flos-aquae*, *Lyngbya birgei*, *Microcystis aeruginosa*, *Oscillatoria prolifica*, and *Oscillatoria rubescens*. Temporally, blooms appeared in the following order: *Anabaena*, *Microcystis*, and *Aphanizomenon*. Numbers of *Anabaena* usually declined with or before onset of other blooms. Water temperature influenced the time of appearance and sequence of bloom formation. Optimum orthophosphate concentrations varied for different species. Accumulation and storage of orthophosphate by algae, its subsequent use in bloom production, and its liberation into the water upon bloom decomposition was evident. Species interaction apparently played a role in bloom persistence and periodicity. (Jones-Wisconsin) W70-02684

COOLING WATER STUDIES AT ELECTRIC POWER STATION,
Duke Power Co., Charlotte, N.C.
For primary bibliographic entry see Field 05B.
W70-02713

DENSITY FLOW REGIME OF ROOSEVELT LAKE,

Battelle Memorial Inst., Richland, Wash. Dept. of Environmental Health and Engineering; and Bureau of Commercial Fisheries, Seattle, Wash. Fish Passage Research Program.

Robert T. Jaske, and George R. Snyder.
Journal of the Sanitary Engineering Division, Proceed of ASCE, Vol 93, No SA3, p 15-28, June 1967. 11 fig, 9 ref.

Descriptors: *Density currents, *Thermal stratification, *Reservoirs, Flow, Temperature, Columbia river.

Identifiers: Canadian Treaty, Flow regime, Lake Roosevelt, Interfacial layers.

The thermal regime of Lake Roosevelt for the summers of 1964 and 1965, when compared with Yih and the Laboratory studies of Debler, shows good agreement regarding the position of the interfacial layer between the upper, relatively stagnant zone and the region of primary flow transport. Further study of the temperature data and confirmation by a limited amount of current measurement shows the location of a second, lower interface roughly conforming to the upper boundary. During the season when stratification occurs, the resulting jet flow travels in a flat, undulating fashion, at times rising above the level of the discharge. Existing theory appears inadequate to fully predict this behavior, although an empirical relationship can be derived to perform engineering analysis. The study confirms the necessity to consider density currents in the management of special releases and in thermal and chemical material balances. Furthermore, the dynamic conditions within the reservoir distort the resulting flow jets to the extent that cooler masses can be by-passed. Another result is the blocking of the formation of 'normal' current jets, and, as a consequence, Lake Roosevelt fills with cool water by displacement from the north without any significant horizontal redistribution. (Richter-Vanderbilt) W70-02716

PHYTOPLANKTON FLORA OF NEWFOUND AND WINNISQUAM LAKES, NEW HAMPSHIRE,
New Hampshire Univ., Durham. Dept. of Botany.
For primary bibliographic entry see Field 05C.
W70-02764

PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 05C.
W70-02766

PHYTOPLANKTON POPULATIONS IN RELATION TO TROPHIC LEVELS OF LAKES IN NEW HAMPSHIRE, U.S.A.
New Hampshire Univ., Durham. Dept. of Botany.
For primary bibliographic entry see Field 05C.
W70-02772

CLADOCERAN FAUNAS ASSOCIATED WITH AQUATIC MACROPHYTES IN SOME LAKES IN NORTHWESTERN MINNESOTA,
Minnesota Univ., Minneapolis. Limnological Research Center.
Henry W. Quade.
Ecology, Vol 50, No 2, p 170-179, 1969. 8 fig, 1 tab, 19 ref.

Descriptors: *Aquatic animals, *Lakes, *Minnesota, Chara, Littoral, Dynamics, Ecology, Daphnia, Alkalinity, Sulfates, Dissolved solids, Depth.
Identifiers: *Cladoceran, *Macrophytes, Lake Itasca (Minn), Autecology, Squaw Lake (Minn), Long Lake (Minn), Elk Lake (Minn), Lake Morrison (Minn), Lake Mary (Minn), Bad Medicine Lake (Minn), Tulaby Lake (Minn), Chydoridae, Sididae, Bosminidae, Daphniidae, Macrothricidae, Polyphemidae, Ceratophyllum demersum, Naias flexilis, Potamogeton natans, Nuphar variegatum, Community coefficient, Per cent similarity.
W70-02798

Cladoceran faunas associated with twelve species of aquatic macrophytes were studied to determine whether Cladocera showed community preference to specific plants. Almost 3000 specimens belonging to 38 Cladocera species were counted. Forty-two collections were made in seven lakes near Lake Itasca (northwest Minnesota), using SCUBA to select appropriate single-species stands of the twelve plants. Some grouping was evident upon tabulating all collections from each plant species. The cladoceran communities resulted in a breakdown of plants into five groups: broad-leaved submerged, fine-leaved submerged, floating-leaved Chara, and others. Water depth and sediment type did not seem to limit distribution of those plant groups that showed specific cladoceran associations. Upon grouping all cladoceran collections from a single lake, two limnologically similar lakes showed distinct cladoceran faunas. Two measurements of community type, namely coefficient of community and per cent similarity, were calculated, the latter giving better results. These measurements supported the hypothesis that aquatic macrophytes control the distribution of the littoral Cladocera. The hypothesis could be further evolved by testing one plant species in many lakes or many plant species in one lake. (Jones-Wisconsin)
W70-02789

THE OBLITERATION OF THE HYPOLIMNION,
Yale Univ., New Haven, Conn. Osborn Zoological Lab.
For primary bibliographic entry see Field 05C.
W70-02797

SOME PHYSICAL AND CHEMICAL FACTORS IN THE METABOLISM OF LAKES,
Saskatchewan Univ., Saskatoon.
D. S. Rawson.

American Association for Advancement of Science Bulletin, Vol 10, p 9-26, 1939. 6 fig, 81 ref.

Descriptors: *Lakes, *Metabolism, Eutrophication, Manganese, Oligotrophy, Oxidation-reduction potential, Dystrophy, Silica, Lake morphometry, Organic matter, Depth, Inhibitors, Epilimnion, Hypolimnion, Benthic fauna, Geology, Temperature, Thermal stratification, Turnovers, Cisco, Trout, Oligochaetes, Oxygen, Thermocline, Methane, Hydrogen sulfide, Hydrogen ion concentration, Calcium, Phosphorus, Nitrogen, Nitrogen compounds, Iron.

Identifiers: *Physical factors, *Chemical factors, Stagnation (Winter), Ooze, Stagnation (Summer), Biological deserts, Trophogenic zones, Oxidation (Bacterial), Transparency, Oxygen excess, Ratio (Oxygen/carbon dioxide), Microcosms, Littoral development, Alkalitrophic lakes, Siderotrophic lakes, Grote's ecological spectrum, Autochthonous sources, Allocchthonous sources.

A comprehensive review of physical and chemical factors influencing the composition of lake waters is presented. The essay is of special importance for a novice in eutrophication research and contains a classic figure delineating relationships between geographic locations of lakes and their trophic nature. The paper critically assesses oxygen deficits as a factor in lake metabolism and concludes that this parameter is most valuable considered in terms of rates on a daily basis rather than as standing quantities. Effects of oxygen as a limiting factor are often confounded with those of concentrations of carbon dioxide and hydrogen sulfide, and of low temperatures. This early paper was among the first to indicate the need for research in the dynamic fine structure including rates of utilization and transfer of the cycling nutrients, nitrogen and phosphorus. (Wilde-Eichhorn--Wisconsin)

W70-02798

ON THE RELATION BETWEEN THE OXYGEN DEFICIT AND THE PRODUCTIVITY AND TYPOLOGY OF LAKES,
Yale Univ., New Haven, Conn. Osborn Zoological Lab.

G. Evelyn Hutchinson.
Internationale Revue der gesamten Hydrobiologie u Hydrographie, Vol 36, p 336-355, 1938. 1 fig, 1 tab, 41 ref.

Descriptors: *Oxygen, *Productivity, *Lakes, Hypolimnion, Plankton, Limnology, Methane, Lake Mendota (Wis), Standing crop, Organic matter, Oligotrophy, Areal, Epilimnion, Depth, Volumetric analysis, Productivity, Eutrophication, Dystrophy, Turnovers, Thermal stratification.

Identifiers: *Oxygen deficit, *Lake typology, Iodine, Crater lakes, Green Lake (Wis), Fureso (Denmark), Calorific values, Devil's Lake (Wis), Geneva Lake (Wis), Okawachee Lake (Wis), Elkhart Lake (Wis), Garvin Lake (Wis), Desmids, Pallett Lake (Wis), Morphometric oligotrophy, Eifel (Germany), Bulgaria, Himalayas, Edaphic oligotrophy, Mysis oculata relicta.

In lakes where hypolimnetic oxygen is exhausted 'real oxygen deficit' is defined as 'apparent oxygen deficit', directly determined, plus the oxygen equivalent of methane, iodine reducing compounds, and other compounds not found in presence of abundant oxygen. Real oxygen deficit may be calculated on actual or absolute basis. In Wisconsin lakes (Green, Black Oak, and Mendota) and the Danish Fureso, rates of development of the absolute hypolimnetic oxygen deficit per square centimeter of hypolimnetic surface, is proportional to mean standing crop of plankton per unit area of lake surface. Strom's method of using hypolimnetic deficit, referred to unit area, as measure of productivity, is justified for harmonic temperate lakes. In Mendota and Fureso, deficit developed in one month, when compared to planktonic organic matter on an energetic basis, approximately represents mean standing crop. Areal deficit in some lakes in different districts is considered. In lakes with maximum depths of 50-75 meters, a complete range from unproductive to productive is

found. Mean areal deficit of several lakes in a single district gives useful characterization of its regional limnology. Lundbeck's distinction between primary (edaphic) and secondary (morphometric) oligotrophy is fundamentally important in lake typology. (Jones-Wisconsin)
W70-02799

SEDIMENTARY PHOSPHORUS IN LAKE CORES—OBSERVATIONS ON DEPOSITIONAL PATTERN IN LAKE MENDOTA,
Wisconsin Univ., Madison. Water Chemistry Lab. Dennis A. Wentz, and G. Fred Lee.
Environmental Science and Technology, Vol 3, No 8, p 754-759, Aug 1969. 5 fig, 1 tab, 20 ref.

Descriptors: *Lakes, *Phosphorus, *Lake sediments, *Cores, Wisconsin, Sludge, Eutrophication, Nutrients, Cycling nutrients, Sediment-water interfaces, Sewage effluents, Water pollution effects, Carbonates, Soil chemistry, Water chemistry, Water pollution sources, Aquatic productivity, Urbanization, Carbon cycle, Iron, Organic matter, Manganese, Sorption, Diagenesis, Marl.

Identifiers: *Lake Mendota (Wis), Phosphorus (Available), Phosphorus (Total), Cultural eutrophication, Autochthonous materials, Freudlich equation, Ratio analysis, Clastic materials, Apatite.

Available P (phosphorus) is an operationally defined fraction of lake sediments available for plant growth. A core, from the deepest part of eutrophic Lake Mendota, Wisconsin, has been analyzed for available P by a method previously described. Ratio, available P/total P, generally ranges between 0.4 and 0.7 in lake sediments. The ratios in the core are examined and conclusions are made regarding deposition of available P in the lake: clastic materials/carbonate carbon, organic carbon/carbonate carbon, available P/carbonate carbon, available P/clastic materials, available P/iron, and iron/carbonate carbon. Deposition rate of available P was constant in marl layer, increased concomitantly with a change from marl to sludge, was maximal about 30 centimeters below sediment-water interface, and decreased gradually from that stratum to surface. Initial increases may correspond with man's appearance in the watershed. Decrease may correspond with cessation of input of city of Madison's sewage effluents in 1899. Evidence derived from this study suggests that available P is probably associated with carbonate portion of the sediments, and that changes in its deposition correlate with events influencing the eutrophication of the lake. (Eichhorn-Wisconsin)
W70-02800

SEDIMENTARY PHOSPHORUS IN LAKE CORES—ANALYTICAL PROCEDURE,
Wisconsin Univ., Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 05A.
W70-02801

EUTROPHICATION AND SENESCENCE IN A GROUP OF PRAIRIE-PARKLAND LAKES IN ALBERTA, CANADA,
For primary bibliographic entry see Field 05C.
W70-02802

21. Water in Plants

ALFALFA WATER TABLE INVESTIGATIONS,
Agricultural Research Service, Reno, Nev. Soil and Water Conservation Research Div.

Rhys Tovey.
ASCE Proc, J Irrig and Drainage Div, Vol 95, No 1R4, Pap 6974, p 525-535, Dec 1969. 11 p, 7 fig, 1 tab, 7 ref.

Descriptors: *Evapotranspiration, *Consumptive use, *Alfalfa, *Groundwater movement, *Water level fluctuations, Water table, Irrigation, Irrigation water, Irrigation efficiency, Water demand, Water utilization, Lysimeters, Soil moisture.

Field 02—WATER CYCLE

Group 21—Water in Plants

Identifiers: Water use (Alfalfa).

Use of water by alfalfa growing under high water table conditions was studied to determine the irrigation requirement. A three-season average of consumptive use and yield of alfalfa, disregarding soil textures, showed an almost straight-line relationship with water table depth for the nonirrigated treatment. The nonirrigated alfalfa showed the effects of static water table depth on the consumptive use and yield of alfalfa. Peak consumptive use occurred when the alfalfa was at or approaching the one-tenth bloom stage and temperatures were high. Only minor differences in the growth of alfalfa were found for the various static water table, soil, and irrigation treatments. The alfalfa plants in the lysimeters showed good root development, with roots in the saturated zone and enlarged white rootlets extending below the water table level. Pan evaporation, net radiation, and the Olivier method adequately predicted cumulative consumptive use for an 8-ft water table, but were low for 2-ft and 4-ft water table depths. None of the prediction methods reflected peak consumptive use periods for alfalfa grown in the presence of static shallow water tables. (Knapp-USGS)

W70-02450

GERMINATION STUDIES OF PERENNIAL GRASS SEEDS,

Central Arid Zone Research Inst., Jodhpur (India). L. D. Ahuja, and C. P. Bhimaya. Annals of Arid Zone, Vol 6, No 2, p 146-152, 1967. 3 tab, 11 ref.

Descriptors: *Arid lands, *Range grasses, *Germination, *Seeds, *Economic efficiency, Range management, Ranges, Seed treatment, Plant physiology, Economics, Research and development, Natural resources, Livestock, Revegetation, Sands, Grasses, Deserts.

Identifiers: *Range rehabilitation, *Perennial grasses, *Rajasthan, India, Reseeding.

The economy of arid Western Rajasthan, India, is closely linked to the livestock industry which must utilize seriously deteriorating ranges. Successful range management will depend upon successful reseeding of appropriate perennial grasses. It is necessary to know germination characteristics and requirements of grasses suited to the area in order to conduct successful and economically efficient range rehabilitation. Germination trials of five species were conducted in petri dishes and in a sand medium. The petri dish trials were found unsuitable. Results of the germination trials in the sand medium are presented in tables. Germination percentages varied significantly between species, with averages ranging from 73.1 to 28.2 percent. Possible physiological reasons for the differences are discussed briefly. (Crouse-Arizona)

W70-02552

PHYTOSOCIOLOGICAL VARIATIONS IN FLORISTIC COMPOSITION OF THE VEGETATION IN THE ARID ZONE: I. MONSOONAL VEGETATION OF THE ALLUVIAL PLAINS,

Central Arid Zone Research Inst., Jodhpur (India). Y. Satyanarayan, and Y. D. Gaur. Annals of Arid Zone, Vol 6, No 2, p 178-199, 1967. 6 tab, 28 ref.

Descriptors: *Arid lands, *Ecology, *Vegetation, *Plant populations, *Plant growth, Alluvium, Ranges, Weeds, Plants, Desert plants, Forages, Xerophytes, Germination, Growth stages, Seeds, Hot winds, Moisture availability, Moisture stress, Soil moisture, Monsoons, Wet seasons, Dry seasons, Climatic data, Competition, Vegetation establishment.

Identifiers: *India, *Annual plants, *Perennial plants.

In arid zones one of the most important vegetation forms is the Therophytes. These are annuals which spring up following a rainy period, move swiftly through their life cycle and survive through the dormant season only in seed form. Therophytes

usually form some of the most palatable forage and are likely to be grazed off before mature seeds develop if the arid range is overgrazed. This paper reports a study of floristic changes that occur in range lands on the alluvial plains near Jodhpur, India. The climate of the area is characterized by low rainfall, high temperatures, low humidity and desiccating winds. The monsoons occur during the summer and the growing season of about 90 days follows onset of the rains. Only five perennials were found in the long dry period before the monsoons. During monsoons perennials increase in number of colonies but decrease in number of individuals. Forbs increase rapidly in number but perennial weeds are slow to germinate. Desirable ephemerals do not compete successfully with weed species which compete more successfully with perennials. Five species were found that could behave as annuals or as perennials depending upon environmental conditions. (Crouse-Arizona)

W70-02553

WATER REQUIREMENTS OF LAWNGRASS,

Nevada Agricultural Experiment Station, Reno; and Agricultural Research Service, Ames, Iowa. Soil and Water Conservation Research Div. For primary bibliographic entry see Field 02D.

W70-02562

EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS. VI: EFFECTS OF THE EXTERNAL OSMOTIC WATER POTENTIAL ON SOLUTE REQUIREMENT, SALT TRANSPORT KINETICS AND GROWTH RATES OF LEAVES,

California Univ., Riverside. Dept. of Soils and Plant Nutrition.

J. J. Oertli.

Soil Science, Vol 105, No 5, p 302-310, 1968. 12 fig, 9 ref.

Descriptors: *Salts, *Soil-water-plant relationships, *Osmotic pressure, *Plant growth, *Arid lands, Salinity, Plant physiology, Air environment, Soil environment, Environmental effects, Vegetation effects, Leaves, Moisture stress, Turgidity, Solutes, Soil water, Cytological studies, Barley, Kinetics, Xylem, Growth rates, Isotherms.

Identifiers: *Water potential, *Salt transport (Plants).

This is one of a series of reports on effects of salt in soil water on plant-water relations. The experiment measured osmotic potential in the petiole and external solution using a Mechrolab vapor pressure osmometer. Turgor pressure of expanding leaf cells was arbitrarily set at 5 bars. The external solute requirement required to maintain this turgor pressure as water potential varied was measured. The results are presented in graphic form. Different turgor pressures would result in parallel shifts in the curve. Results indicate that solute requirements to maintain turgor pressure in leaves increase in proportion to external water stress. Salt transport through the plant decreases in efficiency with increasing salt accumulations. In elongating cells solute requirements must be met continuously. It follows then that cell expansion and leaf growth should be less at either low or high salt concentrations. The optimum level will be somewhere in the middle. Experimental results with barley seedlings supported this conclusion. It was observed that high atmospheric moisture stress, common in arid lands, decreased growth rates by increasing solute requirements. Growth reduction, even without visible leaf injury caused by salinity, is a result of osmotic relationships. (Crouse-Arizona)

W70-02566

DETERMINATIONS OF LEAF AND FRUIT WATER POTENTIAL WITH A PRESSURE CHAMBER,

Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Irrigation Research Lab. Betty Klepper, and R. D. Ceccato.

Horticultural Research, Vol 9, No 1, p 1-7, 1969. 2 plates, 1 fig, 9 ref.

Descriptors: *Plant physiology, *Plant tissues, *Soil-water-plant relationships, *Irrigation efficiency, Horticultural crops, Turgidity, Leaves, Fruit crops, Pressure, Osmotic pressure, Measurement, Instrumentation.

Identifiers: *Water potential, *Pressure chamber, Australia.

The water status of a plant can be measured by its water potential. The water potential of a leaf is the sum of components such as osmotic and matric potential of the cells and pressure potential arising from turgor. All of these affect the chemical potential of leaf water. Research on water status of horticultural plants is particularly important in dry areas since it is valuable in developing guidelines for irrigation practices. The authors report on an experiment conducted in New South Wales, Australia, to test usefulness of a pressure chamber in measuring water potential of both leaves and fruits in horticultural plants. The pressure chamber proved useful and sufficiently accurate for making field measurements of water potential of both leaves and fruit of horticultural crops. The ability to make field measurements of the water status of fruits opens up new possibilities for developing improved irrigation schedules relative to the needs of developing fruit. (Crouse-Arizona)

W70-02568

2J. Erosion and Sedimentation

LINEAR EROSIONAL FURROWS IN SOUTHAMPTON WATER,

Southampton Univ. (England). Dept. of Oceanography.

K. R. Dyer.

Nature, Vol 225, No 5227, p 56-58, Jan 3, 1970. 3 p, 2 fig, 5 ref.

Descriptors: *Erosion, *Estuaries, *Density stratification, *Currents (Water), Streamflow, Tidal effects, Channel morphology, Bed load, Sediment transport, Scour.

Identifiers: *England, Southampton Water.

Linear erosional furrows were found in the bottom of Southampton Water, an estuary on the south coast of England. Transit sonar and echo sounding show the furrows to have a V-shaped cross-section up to 5 m wide and 1 m deep. Individual furrows could be traced for up to 4 km, though bifurcation and interdigitation occurred. They were spaced between 10-25 m apart and each furrow transgressed across the slope into the deeper water towards the mouth of the estuary. The most extensive occurrence of furrows was on the western side of the deep channel. Measurements of current velocity, salinity and temperature at a number of stations at all states of the tide show that Southampton Water is an estuary of moderately stratified type. During the ebb the velocity 1 m from the bottom exceeds 70 cm per sec and the minimum bed shear stress, calculated using the smooth boundary form of the van Karman-Prandtl equation, reaches 6 dynes per sq cm. (Knapp-USGS)

W70-02445

EFFECTS OF UNIT WEIGHT AND SLOPE ON EROSION,

Cornell, Howland, Hayes and Merryfield, Seattle, Wash.; Montana State Univ., Bozeman. Dept. of Civil Engineering; and Montana State Univ., Bozeman. Dept. of Engineering Mechanics. Richard L. Foster, and Glen L. Martin.

ASCE Proc, J Irrig and Drainage Div, Vol 95, No 14, Pap 6984, p 551-561, Dec 1969. 11 p, 9 fig, 2 tab, 6 ref, append.

Descriptors: *Erosion, *Soil erosion, *Slopes, *Soil compaction, Drainage, Rainfall, Roads, Rainfall-runoff relationships, Model studies, Laboratory tests, Statistical methods.

Erosion and Sedimentation—Group 2J

Identifiers: Slope-erosion relations.

Laboratory tests were performed on a fine grained soil to determine the effect of unit weight and slope on erosion and runoff. The tests were conducted on slopes of 1:1, 2:1 and 3:1 using unit weights of 80, 85, 90 and 95 lb per cu ft and a simulated rainfall intensity of 6 in. per hr. After collecting the runoff water and solid particles, the weight of solids eroded and the volume of runoff water were determined. The results and analyses of this study indicate that the slope and unit weight have definite effects on the erosion of unprotected slopes. These indications are: (1) On the flattest slope, the specimens compacted to the lowest unit weight experience the highest rate of erosion; (2) on the steepest slope, the specimens compacted to the highest unit weight experience the highest rate of erosion; and (3) for a given unit weight, there is a unique slope from which the maximum amount of erosion will occur. (Knapp-USGS)
W70-02451

FRICTION FACTORS FOR FLOW IN SAND-BED CHANNELS,

Massachusetts Inst. of Tech., Cambridge. Hydrodynamics Lab.; and Iowa Univ., Iowa City. Inst. of Hydraulic Research.

A. M. Z. Alam, and J. F. Kennedy.

ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6900, p 1973-1992, Nov 1969. 20 p, 9 fig, 4 tab, 28 ref, append.

Descriptors: *Fluid friction, *Alluvial channels, *Roughness coefficient, Roughness (Hydraulic), Sands, Open channel flow, Channel morphology, Dimensional analysis, Stage-discharge relations, Sediment transport, Sedimentary structures.

Identifiers: Hydraulic friction factors.

A new predictor is developed for friction factors of flows in sand-bed channels. A dimensional analysis is pursued to obtain the form of the quantities entering the relation between the geometry of the bed features, the flow properties, and the equivalent shear stress due to the form-drag of the ripples, dunes, etc. Theoretical considerations of the bed stability lead to expressions for the length and height of the bed features in terms of the properties of the bed sediment and flow. These are introduced into the expression yielded by the dimensional analysis, and the resulting frictional relation is quantified with field and laboratory data. The graphical relation of Lovera and Kennedy is used to obtain the flat-bed friction factor. The predictor is evaluated using field data not included in preparation of the graphical relation between the bed-form friction factor, Froude number, and relative roughness. The depth-discharge relations predicted are found to be in good agreement with the measured data. (Knapp-USGS)
W70-02461

LOCAL SCOUR AROUND BRIDGE PIERS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

For primary bibliographic entry see Field 08B.

W70-02462

COORDINATION IN MOBILE-BED HYDRAULICS,

Alberta Univ., Edmonton. Dept. of Civil Engineering.

For primary bibliographic entry see Field 08B.

W70-02463

MOVEMENT OF SAND IN TUNNELS,

Norges Tekniske Hoegskole, Trondheim. River and Harbor Lab.

For primary bibliographic entry see Field 08B.

W70-02465

SCALING PROCEDURES FOR MOBILE BED HYDRAULIC MODELS IN TERMS OF SIMILITUDE THEORY,

University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.

John G. Herbertson.

J Hydraul Res, Vol 7, No 3, p 315-353, 1969. 39 p, 5 fig, 5 tab, 47 ref.

Descriptors: *Sediment transport, *Hydraulic similitude, *Hydraulic models, *Model studies, Sedimentation, Hydraulics, Particle shape, Particle size, Laboratory tests, Statistical methods, Open channel flow.

Identifiers: Hydraulic model scale effects, Mobile-bed hydraulic models.

After a brief discussion of the scope of mobile bed hydraulic models and a literature review, a similarity method (the method of synthesis) is outlined, and is used to critically examine the bases of a typical cross-section of the existing scaling techniques for such models. From this examination, it is concluded that there are two types of procedure: (1) those specifying model bed material of the same density as in the prototype; and (2) those specifying light weight materials. Attention is given to the much neglected depth effect parameter (D/H) in the discussion of these procedures. It is thought that complete similarity of sediment transportation in conventional models is impossible. As a consequence, further experimental work under strictly controlled conditions is required to determine which effects are negligible under given circumstances. A procedure derived from the method of synthesis is suggested. In it, hydraulic and sedimentation time scales need not be different. (Knapp-USGS)
W70-02473

LATERAL MIGRATION OF THE ARKANSAS RIVER DURING THE QUATERNARY-FOWLER, COLORADO, TO THE COLORADO-KANSAS STATE LINE,

Geological Survey, Denver, Colo.

Joseph A. Sharps.

Geological Survey Research 1969, Professional Paper 650-C, p C66-C70, 1969. 5 p, 1 fig, 2 ref.

Descriptors: *Geomorphology, *Alluvial channels, *Meanders, *Colorado, Quaternary period, Pleistocene epoch, Sedimentation, Flood plains, Rivers, Sediment load, Channels, Discharge (Water), Stream erosion.

Identifiers: Arkansas River, Lateral channel-migration.

Former positions of the Arkansas River between Fowler, Colo., and the Colorado-Kansas State line at given times during the Quaternary have been determined from the positions of terraces cut at those times. Lateral migration of the river during Quaternary time was probably caused by the introduction of a greater volume of sediment into the channel from one side than from the other. Gravel deposited by the Arkansas River differs from tributary gravel in composition and grain size. (Knapp-USGS)
W70-02475

COMPARISON OF WIND WAVE AND UNIFORM WAVE EFFECTS ON A BEACH,

California Univ., Berkeley.

For primary bibliographic entry see Field 02L.

W70-02476

SUSPENDED SEDIMENTS UNDER TURBULENT CONDITIONS (RUSSIAN),

L. N. Kashevich.

In: Vodnye Resursy i Vodnoe Khozyaistvo Sibiri (Water Resources and Water Economy of Siberia), Akad Nauk SSSR, Sibirskoye Otdelenie, Geogr Obschestvo, Novosibirsk, USSR, p 24-29, 1968. 6 p, 1 fig, 4 ref.

Descriptors: *Suspended load, *Sediment load, *Rivers, *Reservoirs, *Winds, Mathematical studies, Turbulent flow, Velocity, Turbidity, Weight, Sedimentation rates, Streamflow, Waves (Water). Identifiers: *USSR, Water wave-suspended load relations.

Sedimentation rates and turbidity of suspended loads were analytically investigated. A differential equation of the vertical distribution of suspended load was derived and solved. The mathematical analysis of suspended load characteristics in turbulent waters was compared with the data observed at the Novosibirsk Water Reservoir. Streamflow surface waves lead to the conditions of suspended load saturation and the orbital velocity developed during the vertical redistribution of sediments leads to an increase in the mixing of suspended loads. (Gabriel-USGS)
W70-02481

OOLITIC ARAGONITE AND QUARTZ SAND: LABORATORY COMPARISON UNDER WAVE ACTION,

Army Coastal Engineering Research Center, Washington, D.C.

For primary bibliographic entry see Field 08E.

W70-02624

HYDROGRAPHIC AND SEDIMENTATION SURVEY OF KAJAKAI RESERVOIR, AFGHANISTAN,

Geological Survey of Afghanistan, Kabul. Water Resources Div.

Don Perkins, and James K. Culbertson.

Geol Surv Open-file Rep, Dec 1968. 87 p, 36 fig, 8 tab.

Descriptors: *Dams, *Hydrograph analysis, *Reservoir silting, *Reservoir storage, Sampling, Particle size, Mapping, Sediment discharge, Sediment control, Altitude, Topography, Sedimentation rates, Inflow, River basins. Identifiers: *Afghanistan, Helmand River, Kajakai Reservoir.

This monograph presents the results of a hydrographic and sedimentation survey of Kajakai Reservoir on the Helmand River, Afghanistan, made during the period September through December 1968 for the purpose of defining the current stage-capacity relation and to determine the rate of sedimentation and the sediment range lines. Samples were obtained of the lake bed and in the river upstream from the reservoir. No sediments coarser than about 0.063 millimeter are present on the lake bed surface. The median diameter of sands being transported into the reservoir ranges from 0.040 to 0.110 millimeter. The average annual sedimentation rate is 7,800 acre-feet. Assuming an average density of 800 kg per cubic meter, the estimated average sediment inflow to the reservoir is about 7,700,000 metric tons per year. The decrease in capacity at spillway elevation for the period of 1953 to 1968 due to sediment deposition was 7.8% or 117,700 acre feet. (Gabriel-USGS)
W70-02669

BEDLOAD FORMULAS,

Pennsylvania State Univ., University Park. Coll. of Engineering.

Sam Shulits, and Ralph D. Hill, Jr.

Report available from US Dept of Agriculture, NE Watershed Research Center, Room 111, Research Bldg A, University Park, Pennsylvania, 16802. Pennsylvania State University Hydraulics Laboratory Bulletin, Dec 1968. 212 p, 23 fig, 8 tab, 85 ref.

Descriptors: *Bed load, *Sediment transport, *Equations, *Reviews, Computer programs, Bibliographies, Digital computers, Sediment discharge, Discharge (Water), Tractive forces, Open channel flow. Identifiers: *Bed load formulas.

Field 02—WATER CYCLE

Group 2J—Erosion and Sedimentation

Formulas for computing bed load are reviewed, and FORTRAN program listings are given for digital computer solution of 14 of them. The programs are for the formulas of Schoklitsch, Meyer-Peter, Casey, Haywood, Straub, Waterways Experiment Station, Shields, Kalinske, Meyer-Peter and Muller, Eizerman and Frijlink, Laursen, Rottner, and Einstein. Results of the formulas are compared by calculating and plotting sediment discharge against water discharge for all of them. Each formula is presented in its original form and units, and its use is explained as the originator intended. It is concluded that 3 of the formulas give the best results, with adequate agreement with data. The Schoklitsch (1934) formula is selected as the best relation of bed load to discharge. The Straub and the Meyer-Peter and Muller formulas are selected as the best relations of bed load to tractive force. The 3 formulas are valid for effective particle diameters from 0.3 to 7 mm. The Schoklitsch (1934) formula is proposed as the best of the 3 because of its simple form and because it produces directly a bed load-discharge rating curve. (Knapp-USGS)

W70-02671

REVESTMENTS FOR BANK PROTECTION USING VERY ROUGH-SURFACED FERROCONCRETE ELEMENTS (FRENCH),

Institut d'Aménagement et d'Economie de l'Eau, Warsaw (Poland).

For primary bibliographic entry see Field 08A.
W70-02696

SHORE EROSION AND PROTECTION ST. LAWRENCE RIVER-CANADA,

Department of Public Works (Canada).

For primary bibliographic entry see Field 08A.
W70-02697

HISTORICAL, FIELD AND EXPERIMENTAL STUDIES OF THE SUEZ CANAL BANK PROTECTION,

Suez Canal Authority Research Center, Ismailia (Egypt); and International Commission for Irrigation and Drainage.

For primary bibliographic entry see Field 08A.
W70-02698

METHODS OF BANK PROTECTION FOR PORT, INLAND WATER-WAY AND RIVER,

Toa Harbour Works Co. Ltd., Tokyo (Japan). Engineering Dept.

For primary bibliographic entry see Field 08A.
W70-02699

EROSION PREVENTION EXPERIMENTS,

Connecticut Univ., Storrs.

For primary bibliographic entry see Field 04D.
W70-02730

2K. Chemical Processes

THE MECHANISM OF PHOTOSYNTHESIS,

Harvard Univ., Cambridge, Mass. Biological Labs. R. P. Levine.

Scientific American, Vol 221, No 6, p 58-70, Dec 1969. 11 fig, 1 photo.

Descriptors: *Photosynthesis, Chlorophyll, Fluorescence, Energy transfer, Light, Phosphates. Identifiers: Emerson enhancement effect, Chemical processes, Carotenoids, Phycobilins, Cytochromes, NADP, NADPH, ATP. Photochemistry, Chlorophyll a, Chlorophyll b, Chloroplasts, Phycocyanobilin, Hill-Bendall scheme, Mitochondria, Component Q, Ferredoxin reducing substance, Plastocyanin, DCMU, Electron transport.

In a state-of-knowledge review, author summarizes information gaps and current hypotheses on

photosynthesis, and important biochemical knowledge bearing on postulated new compounds mediating electron transport in the following sequence: entrapment of light energy, conversion to chemical energy, electron transport, production of NADPH (reduced nicotinamide adenine dinucleotide disphosphate) and ATP (adenosine triphosphate), and carbon dioxide fixation. New information suggests that two, rather than one, light systems operate in the photosynthetic process used by algae and higher plants. Described as the Emerson enhancement effect, both systems can be driven by light of wavelengths less than 680 nanometers; only one, by longer wavelengths. A different species of chlorophyll is apparently involved in the reaction center of each system. Fluorescence measurements played a key role in developing the hypotheses. Excitation energy is transferred to chlorophyll a by chlorophyll b, the carotenoids and phycobilins. Chlorophyll a cannot be used for photosynthesis, it alone is dissipated as fluorescence. In the initial light system, which remains the least understood, four electrons and four protons are extracted from water with the evolution of a molecule of oxygen. No references, but key scientists and their schools are identified. (Gerhold-Wisconsin)
W70-02503

EFFECT OF YELLOW ORGANIC ACIDS ON IRON AND OTHER METALS IN WATER,

Minnesota Univ., Minneapolis. Limnological Research Center.

Joseph Shapiro.
Journal American Water Works Association, Vol 56, No 8, p 1062-1082, Aug 1964. 11 fig, 5 tab, 29 ref.

Descriptors: *Organic acids, *Iron, *Metals, *Water chemistry, Color, Water quality, Water pollution effects, Lakes, Ionization, Humus, Bogs, Humic acids, Peat, Hydrogen ion concentration, Copper, Manganese, Cobalt, Chelation, New Jersey, Connecticut, New York, Dystrophy.

Identifiers: *Metallic ions, *Organic acids (Yellow), Sphagnum Zinc, Carboxylic groups, Zoar Lake (Conn), Bantam Lake (Conn), Schulze Hardy rule, East Twin Lake (Conn), Charlottburg Reservoir (NY), Litchfield (Conn), Lake Hopatcong (NJ), Pinecliff Lake (NJ), Lake Musconetcong (NJ), Quassapaug Lake (Conn), Peptization.

By the use of filtration, freezing, amberlite column, hydrochloric acid, and extraction with n-butanol, a 900-liter sample of colored lake water rendered about 2 grams of ash-free yellow acidic substance. In the author's opinion, this material consists primarily of aliphatic polyhydroxy carboxylic acids enriched in nitrogen to 1.2-1.9%. The study of this 'yellow acid' included determination of its molecular weight, iron-retention capacity, chelation and peptization, influence of electrolytes and pH of the medium, and behavior toward copper, manganese, cobalt, and zinc. The results suggested the ionization hypothesis, according to which the initial precipitation of iron or iron-adsorbed yellow acids is followed by peptization when the pH has been raised sufficiently to ionize most of the carboxyl groups. The large quantities of iron held in apparent solution in colored waters may be in the form of a protected colloid; where the ratio of color to iron is high, a part of importance may be played by chelation. (Wilde-Wisconsin)
W70-02505

POLYWATER: PROTON NUCLEAR MAGNETIC RESONANCE SPECTRUM,

Battelle Memorial Inst., Columbus, Ohio; and Maryland Univ., College Park, Dept. of Chemistry. For primary bibliographic entry see Field 01A.
W70-02618

THERMODYNAMIC MIXING PROPERTIES OF NaCl LIQUIDS,

Harvard Univ., Cambridge, Mass. Dept. of Geological Sciences.

D. R. Waldbaum.

Geochimica et Cosmochimica Acta, Vol 33, No 11, p 1415-1427, Nov 1969. 13 p, 4 fig, 4 tab, 46 ref.

Descriptors: *Geochemistry, *Aqueous solutions, *Thermodynamic behavior, *Liquids, *Potassium compounds, Sodium compounds, Entropy, Energy, Water temperature, Crystallization.

Identifiers: *NaCl-KCl liquids thermodynamics.

The excess Gibbs energies and entropies of mixing of NaCl-KCl liquids have been calculated using previously derived mixing parameters of the crystalline solutions and the temperature and composition of the minimum (657 deg C, 48.5 mole percent KCl) in the melting region. Margules parameters of the liquid based on the present formulation differ by 1 KCl at 800 deg C from the values obtained in electrochemical studies. Solidus and liquidus curves calculated from these results are compared with experimental data from 12 previous studies of the melting region. Alkali buffer potentials, in this system, calculated from the mixing properties of the liquid range from -14.6 plus or minus 0.5 kcal at 796 deg C to -5.90 plus or minus 0.05 kcal at the minimum, to +7.6 plus or minus 0.5 kcal at 770 deg C. (Gabriel-USGS)
W70-02627

GEOCHEMISTRY AND ORIGIN OF FORMATION WATERS IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. STABLE ISOTOPES OF HYDROGEN AND OXYGEN,

Research Council of Alberta, Edmonton; and Geological Survey, Denver, Colo.

Brian Hitchon, and Irving Friedman.

Geochimica et Cosmochimica Acta, Vol 33, No 11, p 1321-1349, Nov 1969. 29 p, 8 fig, 7 tab, 45 ref.

Descriptors: *Geochemistry, *Water sources, *Aquifers, *Groundwater, *Sedimentary basins (Geological), Stable isotopes, Hydrogen, Oxygen, Oil fields, Surface waters, Sea water, Deuterium, Statistical methods, Sulfides, Carbonates, Porosity, Shales.

Identifiers: Western Canada basin geochemistry.

Stable isotopes of hydrogen and oxygen, together with chemical analyses, were determined for surface (20 samples), shallow potable formations (8), and oil and gas field waters (79 samples). The observed isotope ratios can be explained by mixing of surface waters and diagenetically modified sea water. Mass balances for deuterium and total dissolved solids in the western Canada sedimentary basin demonstrate that the present distribution of deuterium in the formation waters of the basin can be derived through mixing of the diagenetically modified sea water with fresh water and their subsequent movement through the basin. Statistical analyses of the isotope data indicate an insignificant rate of deuterium exchange between water and hydrogen sulfide and considerable exchange of oxygen isotopes between water and carbonate minerals. (Gabriel-USGS)
W70-02628

PARTICULATE ALUMINUM AND IRON IN SEA WATER OFF THE SOUTHEASTERN COAST OF THE UNITED STATES,

Duke Univ., Beaufort, N.C. Marine Lab.

Larry P. Atkinson, and Unnstein Stefansson.

Geochimica et Cosmochimica Acta, Vol 33, No 11, p 1449-1453, Nov 1969. 5 p, 2 fig, 2 tab, 6 ref.

Descriptors: *Geochemistry, *Iron, *Sea water, *Coasts, *United States, Estuaries, Rivers, Salinity, Water chemistry, Continental shelf, Continental slope, Analytical techniques, Mapping, Sampling, Runoff, Seasonal, Chlorides, Clays.

Identifiers: Southeastern coast, Chesapeake Bay, Cape Kennedy.

Sea water samples (39) collected during three cruises of the R/V Eastward in the shelf waters between Chesapeake Bay and Cape Kennedy were analyzed to determine their Al and Fe content. The study indicates that concentrations of particulate iron and aluminum in river and shelf waters of the

Chemical Processes—Group 2K

eastern United States are indirectly related to salinity but show a loss greater than that from simple mixing. East coast concentrations of particulate iron are less than comparable west coast concentrations. (Gabriel-USGS)
W70-02630

ALKALINITY BUDGET OF THE COLUMBIA RIVER,

Oregon State Univ., Corvallis. Dept. of Oceanography; Federal Water Pollution Control Administration, Washington, D.C. Div. of Engineering Development; and Idaho Univ., Moscow. Dept. of Chemistry.

P. Kilho Park, George R. Webster, and Roy Yamamoto.

Limnology and Oceanography, Vol 14, No 4, p 559-567, July 1969. 9 p, 3 fig, 4 tab, 17 ref. Grants GP-2232, GP-2876, and GP-5317 (NSF) Res Contract Nonr-1286 (10)-ONR.

Descriptors: *Alkalinity, *River flow, *Columbia River, Carbonates, Water chemistry, Dissolved solids, Silicates, Calcium carbonate, Estuaries, River basins, Weathering, Sampling, Mapping, Phosphates, Nitrates, Streamflow, Discharge (Water).
Identifiers: Alkalinity budget.

Columbia River alkalinity essentially consists of carbonate alkalinity (94%) with some silicate alkalinity where dissolved silicate concentration is high. Phosphate and borate contribute insignificantly to the overall alkalinity. The river delivered 11 megartons of calcium carbonate to the Pacific Ocean during the water year 1963. Regardless of high seasonal flow-rate variance, the river alkalinity near the river mouth shows little variation with an average value of 1 meq/liter. (Gabriel-USGS)
W70-02642

SOLUBILITIES OF NITROGEN, OXYGEN, AND ARGON IN DISTILLED WATER,
Amherst Coll., Mass. Dept. of Physics.
Cornelius E. Klots, and Bruce B. Benson.
Journal of Marine Research, Vol 21, p 48-57, 21, 1, 1963. 1 fig, 4 tab, 21 ref.

Descriptors: *Solubility, *Nitrogen, *Oxygen, *Argon, Temperature.
Identifiers: Bunsen absorption coefficient, Distilled water.

The solubilities of nitrogen, oxygen and argon in distilled water in the temperature range 2-27 deg C have been measured with an estimated accuracy of 0.1%. Both absolute and solubility ratio techniques were employed. Tabulations are present of the Bunsen absorption coefficients and Henry's law constants for nitrogen, oxygen and argon and the ratio of the absorption coefficients to those for nitrogen. The solubilities found by Fox, Winkler, Hamberg and others are compared. It is concluded that the values of oxygen solubility in Standard Methods are high except at the lowest temperatures, and the values of the ASCE research committee are slightly low above 15 deg C. (Rietveld-Vanderbilt)
W70-02701

SOLUBILITY OF ATMOSPHERIC OXYGEN IN WATER,
Harvard Univ., Cambridge, Mass. Sanitary Engineering Div.
J. Carroll Morris, Werner Stumm, and Hend A. Galal.

Journal of the Sanitary Engineering Division, Proceed of ASCE, Vol 87, SA 1, p 81-86, Jan 1961. 2 fig, 2 tab.

Descriptors: *Solubility, *Dissolved oxygen, Temperature, Saturation.
Identifiers: Winkler method, Bunsen absorption coefficient, Distilled water.

The apparatus for obtaining saturation of water with air at constant pressure and the apparatus for manometric determination of oxygen solubility are described in some detail. Two tables give the saturation values for oxygen in water as obtained by the above mentioned equipment. The data obtained by the TVA group are in concordance with this data, however, two facts are missing in the description of the Elmore and Hayes study: (1) if the air being equilibrated with water was saturated with water vapor, (2) no mention of correction of barometric pressures to standard conditions. This article is only a prediscussion of a more complete study for the USPHS. (Rietveld-Vanderbilt)
W70-02702

DETERMINATION OF DISSOLVED OXYGEN BY THE WINKLER METHOD AND THE SOLUBILITY OF OXYGEN IN PURE WATER AND SEA WATER,

Water Pollution Research Lab., Stevenage (England).

H. A. C. Montgomery, N. S. Thom, and A. Cockburn.

Journal of Applied Chemistry, Vol 14, p 280-296, July 1964. 4 fig, 11 tab, 65 ref.

Descriptors: *Solubility, *Dissolved oxygen, Seawater, Temperature.

Identifiers: Winkler method, Adeney-Becker law, Distilled water.

Values for the solubility of oxygen in water obtained by a modification of the Winkler method are shown to be low because of losses of iodine vapor. Iodine vapor is also lost in two of the standard modifications of the Winkler method in common use, the amount lost depending on the technique of the analyst. The volatilization of iodine can be avoided by the use of the alkaline iodide reagent of Pomeroy and Kirschman; a procedure employing this reagent is described. Interference by nitrates and ferric iron may be eliminated by sodium azide and phosphoric acid respectively. The accuracy of the Winkler method, modified to prevent the loss of iodine vapor, has been confirmed using gaseous oxygen as a standard. Using the procedure recommended, determinations have been made of the solubility of atmospheric oxygen in distilled water between 0.4 deg and 37 deg, and in sea water between 2 deg and 27 deg. The results for distilled water are in excellent agreement with those of Klots and Benson between 2 deg and 27 deg; the new values for sea water agree fairly well with those of Fox. The values in Standard Methods are shown to be high, except at the lowest temperatures, and the values of the ASCE research committee to be low above 15 deg C. In measurements of the rate of solution of oxygen, the approach to equilibrium using these values was consistent with the law of Adeney and Becker. This article contains 65 references. (Rietveld-Vanderbilt)
W70-02705

NEW MEASUREMENTS OF OXYGEN SOLUBILITY IN PURE AND NATURAL WATER,

Johns Hopkins Univ., Baltimore, Md. Dept. of Oceanography.

James H. Carpenter.

Limnol Oceanogr, Vol 11, p 264-277, 1966. 5 fig, 5 tab, 29 ref.

Descriptors: *Solubility, *Dissolved oxygen, *Temperature, *Chlorides, Seawater.

Identifiers: *Chlorinity, Titrimetric method, Gasometric method, Winkler method, Distilled water.

The measurements of oxygen solubility in distilled water and dilutions of seawater were made with the Winkler titrimetric method after an extended study of its errors. The system and instruments used are described. The measurements were made over the temperature range 0.5 deg to 35 deg C. Nonlinear dependence of oxygen solubility on chlorinity was found. Interpolation tables of the data have been prepared. The accuracy of the techniques was ap-

proximately 0.1%, so the tables appear to be more reliable than those in current use. Because many of the existing field data have been collected using techniques for the Winkler method that introduce significant systematic errors due to volatilization and air oxidation errors, the use of the reported solubility values with these field data will produce misleading results. The values determined agree well with the values of Klots and Benson, and with those of Montgomery, Thom, and Cockburn. This article contains 21 references. (Rietveld-Vanderbilt)
W70-02712

A FLUOROMETRIC METHOD FOR DETERMINING TRACE QUANTITIES OF FLUORIDE,

Missouri Univ., Columbia. Dept. of Chemistry.

For primary bibliographic entry see Field 07B.

W70-02726

A FLUOROMETRIC DETERMINATION OF IODIDE ION,

Missouri Univ., Columbia. Dept. of Chemistry.

For primary bibliographic entry see Field 07B.

W70-02727

FLUOROMETRIC DETERMINATION OF OXALATE ION,

Missouri Univ., Columbia. Dept. of Chemistry.

For primary bibliographic entry see Field 07B.

W70-02728

CHEMISTRY OF THE OXIDANT, FERRATE, ITS INTERACTION WITH SPECIFIC ORGANICS FOUND IN WASTE WATER,

Kentucky Water Resources Inst., Lexington.

For primary bibliographic entry see Field 05G.

W70-02738

THE DETERMINATION OF THE ENGINEERING THERMO-PHYSICAL PROPERTIES OF SOLUTIONS CONTAINING DISSOLVED SOLIDS,

Connecticut Univ., Storrs. Inst. of Water Resources.

David A. Fisher, and James G. Daley.
Research Project Technical Completion Report, Nov 1970. 4 p, 7 tab. OWRR Project A-010-CONN.

Descriptors: *Seawater, *Enthalpy, *Entropy, *Specific heat.

The value of enthalpy of seawater concentrates above their value at 0 deg C has been determined in the temperature range 0 deg C to 200 deg C based on measurements made of the heat given off by samples of seawater when cooling, from some temperature to 0 deg C. These concentrates ranged from a salinity of 1% to 28%. From this data a polynomial expression for enthalpy has been determined which, together with other thermodynamic considerations, permits the evaluation of specific heat and entropy in this range of temperature and concentration. Tables have been prepared giving enthalpy, entropy and specific heat in this range for which the values of enthalpy and entropy at 0 deg C are based on the heat of mixing of sodium chloride solutions of equivalent dissolved solids.
W70-02749

AN INVESTIGATION OF THE STRUCTURAL CHEMISTRY OF YELLOW ORGANIC MATTER IN FRESH WATER,

Rhode Island Univ., Kingston. Dept. of Agricultural Chemistry.

George T. Felbeck, Jr.
Technical Completion Report, Rhode Island Water Resources Center, 1969. 6 p. OWRR Project A-018-RI.

Descriptors: *Yellow organic matter, *Humic acid, *Bacteria, *Fungi, *Fresh water, *Aquatic microflora.

Field 02—WATER CYCLE

Group 2K—Chemical Processes

Colonies of aquatic microflora were isolated from samples of highly colored pond water. From the large number of bacteria and fungi isolated on agar plates only a very few produced yellow-colored exudates when grown in a submerged culture. None of the pigments produced in this fashion were water soluble. The only yellow-colored water soluble materials that were obtained occurred in cultures of fungi grown under non-agitated conditions and with the presence of aerial mycelia. Therefore, these results are consistent with previous chemical evidence that the yellow-colored organic matter in fresh water is derived either directly from soil fungal products or indirectly through the breakdown of the soil humic acid polymers.

W70-02769

2L. Estuaries

COMPARISON OF WIND WAVE AND UNIFORM WAVE EFFECTS ON A BEACH,

California Univ., Berkeley.

Peter Truman Kraai.

Shore and Beach, Vol 37, No 2, p 60-71, Oct 1969, 12 p, 19 fig, 1 tab, 18 ref.

Descriptors: *Waves (Water), *Beaches, *Sediment transport, *Model studies, Sands, Beach erosion, Bed load, Winds, Profiles, Ocean waves, Currents (Water), Deposition (Sediments), Littoral drift, Shores, Surf.

Identifiers: *Beach erosion models, Wave-making machines.

A series of two dimensional experiments were made in a wave channel to compare the nearshore beach profiles formed by wind-generated waves with the profiles formed by periodic machine-generated waves. Although equilibrium was easily obtained in the case of uniform periodic wave exposure, it was not possible to achieve equilibrium when the beach was exposed to wind waves. The basic current systems differed in the offshore zone for the two cases. No theoretical equilibrium beach profile exists for the case of a beach exposed to locally generated wind waves. The basic mechanism for the movement of sand seaward during the winter season is the offshore bottom current which is a result of the wind setup experienced during intense local storms in the winter. (Knapp-USGS)

W70-02476

SALT-WATER ENCRONACHEMENT INTO AQUIFERS.

Proceedings of Symp held at Louisiana State Univ., Baton Rouge, May 4-5, 1967. Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, Oct 1968, 192 p, 38 fig, 15 tab, 91 ref. OWRR Proj No A-004-LA.

Descriptors: *Saline water intrusion, *Aquifers, Hydrogeology, Water management (Applied), New York, Florida, California, Groundwater movement, Surface-groundwater relationships, Water law, Legal aspects, Drainage, Withdrawal, Administrative agencies.

Identifiers: Aquifer management.

A symposium record contains discussions of salt water encroachment into aquifers in Florida, New York and California, Management of aquifers, encroachment control, hydrogeology, and legal aspects of encroachment. Each discussion consists of a paper presented as a preprint, a short introductory statement by the author, and discussion by the symposium participants. (See also W70-02485 thru W70-02492). (Knapp-USGS)

W70-02484

COMBATING SALT-WATER ENCRONACHEMENT INTO THE BISCAYNE AQUIFER OF MIAMI, FLORIDA,

Dade County Engineering Dept., Miami, Fla.

F. D. R. Park.

Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 31-56, Oct 1968, 26 p, 14 fig, 2 tab, 16 ref. OWRR Proj No A-004-LA.

Descriptors: *Saline water intrusion, *Aquifers, *Florida, *Water management (Applied), Legal aspects, Water law, Water conservation, Land management, Drainage, Withdrawal, Administrative agencies.

Identifiers: Water quality management.

Urbanization of Dade Co., Florida and attempts to drain the Everglades have lowered the water table. During periods of drought, the current withdrawal rate of fresh water allows salt-water intrusion. Recharge from rainfall periodically pushes salt water to the sea. It is desirable to artificially hold a high water level to offset intrusion during droughts. Salinity dams, prevention of further primary drainage, and navigation channels are used in salinity control. Little opposition has been encountered in enforcement of the salt barrier line on private lands. The main enforcement difficulties are caused by the Public Works and Mosquito Control Units. Court decisions subordinate riparian rights to the public need of an uncontaminated fresh water supply. Lesser pollution problems arise from industrial and domestic discharges. An effective answer lies in county-wide sewage collection and disposal. (See W70-02484). (Knapp-USGS)

W70-02485

SALT-WATER INTRUSION IN SOUTHEASTERN FLORIDA,

Central and Southern Florida Flood Control District, West Palm Beach, Fla.

Robert Grafton.

Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 15-30, Oct 1968, 16 p, 1 fig. OWRR Proj No A-004-LA.

Descriptors: *Saline water intrusion, *Aquifers, *Florida, *Water management (Applied), Aquifers, Hydrogeology, Surface-groundwater relationships, Water law, Legal aspects, Water conservation, Land management, Drainage, Withdrawal, Administrative agencies.

Identifiers: Water quality management.

Overdrainage as a result of urbanization and geological conditions resulted in salt-water intrusion into southeastern Florida. After massive flood damage in 1957 and 1958, the Central and Southern Florida Flood Control District was established to acquire lands, represent local interests, raise funds, and operate projects in cooperation with the Federal Government to promote flood control and water preservation. Further legislation is required to broaden the scope of the F.C. D., especially in salt-water intrusion. With the exception of Dade and Broward Counties, little is being accomplished by counties under the guidance of the State Board of Conservation, Department of Water Resources. Increased population is endangering lands committed to conservation areas. However, activities by special agencies against salt-water intrusion in southeastern Florida continue to gain momentum. (See W70-02484). (Knapp-USGS)

W70-02486

PLANNING AND PROVIDING AN ADEQUATE SUPPLY OF WATER FOR ORANGE COUNTY, CALIFORNIA,

Orange County Water District, Santa Ana, Calif.

Howard W. Crooke.

Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 89-103, Oct 1968, 15 p, 2 tab. OWRR Proj No A-004-LA.

Descriptors: *Water management (Applied), *Saline water intrusion, *Aquifers, *California, *Artificial recharge, Pit recharge, Water spreading, Injection wells, Water law, Legal aspects, Overdraft, Taxes.

Identifiers: *Water quality management, *Orange County (Calif).

In the past 17 years, the Orange County Water District of California has purchased more than 1.7 million acre-feet of water to recharge and replenish the Orange County groundwater basin. This water, which was brought 300 miles from the Colorado River, cost \$22.5 million. About one-third of this was financed from advalorem taxes levied on all real property within the District; two-thirds was financed from replenishment assessments levied on all water produced from the groundwater supply and paid by those who pumped the water. This extensive replenishment is an integral part of a groundwater management program geared to meet the water needs of an area that has experienced an unprecedented and continuing economic boom. (See W70-02484). (Knapp-USGS)

W70-02487

PROTECTING LONG ISLAND AQUIFERS AGAINST SALT-WATER INTRUSION,

New York State Dept. of Conservation, Albany, Div. of Water Resources.

Francis W. Montanari, and Walter G. Waterman. Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 59-87, Oct 1968, 29 p, 9 fig, 2 tab, 26 ref. OWRR Proj No A-004-LA.

Descriptors: *Saline water intrusion, *Aquifers, *New York, *Water management (Applied), *Artificial recharge, Saline water-freshwater interfaces, Reclaimed water, Water law, Legislation, Legal aspects, Hydrogeology, Desalination.

Identifiers: Water quality management.

Salt water intrusion in New York involves only the perimeter of Long Island. The problem is compounded by direct contact between the aquifers and the ocean. All Long Island groundwater comes from infiltration with approximately 50% absorption into the aquifers. Since 1933, legislation has been enacted to regulate the groundwater extraction and to license well drillers. The main causes of salt-water intrusion are overpumpage and a reduction in availability of recharge water as a result of urbanization. Projects undertaken to relieve overpumpage are: (1) reservoirs to collect surface water, (2) acquiring pumping rights of sparsely populated areas, and (3) construction of a desalination plant. Plans are under way to salvage 97 mgd of presently wasted sewage water for injection. Presently Long Island is using 15 acres of recharge basins with a capacity of 57 million gallons. Present efforts, such as recharging, are being offset by wasteful sewage discharge. (See W70-02484). (Knapp-USGS)

W70-02488

THE CHALLENGE OF WATER MANAGEMENT: ORANGE COUNTY WATER DISTRICT, CALIFORNIA,

Orange County Water District, Santa Ana, Calif.

Langdon W. Owen.

Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 105-125, Oct 1968, 21 p, 5 fig, 2 tab. OWRR Proj No A-004-LA.

Descriptors: *Water management (Applied), *Saline water intrusion, *Aquifers, *California, *Injection wells, Artificial recharge, Observation wells, Water reuse, Reclaimed water, Groundwater barriers, Water quality.

Identifiers: *Water quality management, *Orange County (Calif).

The technical aspects of effective basin management of Orange County, California water supplies are described. Reliance has been placed on both surface water and groundwater to meet county needs. Surface water is obtained from the Colorado and Santa Ana Rivers and direct precipitation. Groundwater comes from the South Coastal Basin. Feasible use of these sources is dependent on safe withdrawal of large volumes of groundwater during periods of surface water shortage and the ability to sink large quantities of water into the basin when surplus surface water is available. Salt-water intrusion will be controlled by a hydraulic barrier of in-

jection wells. The major problem encountered in injecting reclaimed and surface water is the quality of the available water. Blending of surface water and groundwater provides a desirable composite water source. Computer models have greatly facilitated working knowledge of the groundwater basin operation. (See W70-02484). (Knapp-USGS) W70-02489

THE HYDROGEOLOGIC SETTING IN LOS ANGELES COUNTY, CALIFORNIA, Los Angeles County Flood Control District, Calif., Water Conservation Div. Clinton Milne.

Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 127-151, Oct 1968. 25 p, 8 fig, 7 tab, 11 ref. OWRR Proj No A-004-LA.

Descriptors: *Hydrogeology, *Saline water intrusion, *Aquifers, *California, *Artificial recharge, Water management (Applied), Geology, Injection wells, Drawdown, Water resources development. Identifiers: *Water quality management, Aquifer management, Los Angeles County (Calif.).

Over 80% of the water levels in the principal aquifers underlying the 470-square mile coastal plain area of Los Angeles County, California are below sea level. As a result, aquifers of Pleistocene age, situated at depths down to 750 feet in the critical areas, have been intruded by sea water. The volume of this intrusion is estimated to be 700,000 acre feet. Artificial replenishment is accomplished by the spreading of local storm runoff and the injection of both imported Colorado River water and reclaimed water. Management of groundwater basins will maintain below sea level the water tables underlying most of the coastal plain. Sea-water intrusion will be prevented by the injection of fresh water, which will also provide a major portion of the groundwater replenishment. (See W70-02484). (Knapp-USGS) W70-02490

THE AMELIORATION OR PREVENTION OF SALT-WATER INTRUSION IN AQUIFERS - EXPERIENCE IN LOS ANGELES COUNTY, CALIFORNIA, Los Angeles County Flood Control District, Calif. Arthur E. Brumpton.

Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 153-168, Oct 1968. 16 p, 1 fig, 8 ref. OWRR Proj No A-004-LA.

Descriptors: *Water management (Applied), *Saline water intrusion, *Injection wells, *California, Groundwater barriers, Artificial recharge, Aquifers, Water reuse, Construction costs, Operating costs. Identifiers: *Water quality management, *Los Angeles County (Calif.).

Underground storage from winter storms is used in Los Angeles County, California with the pressure-ridge method for recharge of the aquifers for deterring saline intrusion. A line of injection wells create a pressure field much like a continuous curtain wall. Waterlogging has been controlled in low areas by seaward extraction along with pressure-ridge injection. Injected water must be of high quality to prevent clogging of wells, increase well life, and reduce well-cleaning costs. Observation wells are needed at critical points along the barrier line to monitor the groundwater elevation. The location of the barrier line has allowed a certain amount of salt water to be cut off, or trapped behind the barrier. The cost of injected water for 1966, \$13.00 per acre-foot did not include the cost of supply water, amortized capital outlay per well, pipelines, and other appurtenances. The uncompleted pressure-ridge system is working as planned. (See W70-02484). (Knapp-USGS) W70-02491

LEGAL AND ECONOMIC ASPECTS OF SALT-WATER ENCROACHMENT INTO COASTAL AQUIFERS, Bookman and Edmonston, Glendale, Calif. Max Bookman. Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 169-192, Oct 1968. 24 p, 30 ref. OWRR Proj No A-004-LA.

Descriptors: *Saline water intrusion, *Aquifers, *Water management (Applied), *California, *Legal aspects, Costs, Economics, Administrative agencies, Flood control, Artificial recharge, Water reuse, Water rights, Water law.

Identifiers: Water quality management, Los Angeles County (Calif.).

An integral part of salt-water intrusion prevention is control and reduction of groundwater production, which, in Los Angeles County, California, required court action. Legislative action was also necessary to empower local water districts to construct, operate, and finance salt-water prevention facilities. At present, 70% of the water is imported. Implementation of controls was a 3-step process: (1) sharing of imported river water with upstream owners; (2) injunctions against Coastal and Central basin pumpers; and (3), establishment of a salt-water barrier. Barrier financing came through ad valorem taxes and district general funds. Other legislation provided for financing enforcement. Salt-water prevention in the West Coast basin is administered by 6 state and local agencies and one citizens' association. This arrangement has proved successful and economical. The control of pumping and reduction of groundwater use by pricing is not sufficient to halt salt-water intrusion. Court actions and their consequences are an important economic factor. (See W70-02484). (Knapp-USGS) W70-02492

THE TRANSFORMATION OF A SOLITARY WAVE OVER AN UNEVEN BOTTOM, Massachusetts Inst. of Tech., Cambridge. Hydrodynamics Lab.

O. S. Madsen, and C. C. Mei.
Journal of Fluid Mechanics, Vol 39, Part 4, p 781-791, Dec 1969. 11 p, 7 fig, 3 tab, 19 ref.

Descriptors: *Waves (Water), *Mathematical models, *Hydraulic models, Numerical analysis, Mathematical studies, Frequency, Energy, Beaches, Continental shelf.

Identifiers: Wave transformation.

Based on a set of approximate equations for long waves over an uneven bottom, numerical results show that as a solitary wave climbs a slope the rate of amplitude increase depends on the initial amplitude as well as on the slope. Results are also obtained for a solitary wave progressing over a slope onto a shelf. On the shelf a disintegration of the initial wave into a train of solitary waves of decreasing amplitude is found. Experimental evidence is also presented. (Knapp-USGS) W70-02625

GRAVITY WAVES OVER A NON-UNIFORM FLOW,

Technische Hogeschool Twente, Enschede (Netherlands).
H. G. M. Velthuizen, and L. Van Wijngaarden.
Journal of Fluid Mechanics, Vol 39, Part 4, p 817-829, Dec 1969. 13 p, 5 fig, 8 ref, append.

Descriptors: *Waves (Water), *Mathematical models, Mathematical studies, Numerical analysis, Viscous flow, Hydraulics, Energy, Equations, Boundary layers, Critical flow, Non-uniform flow. Identifiers: Viscous hydrodynamics.

Propagation of small amplitude gravity waves over a flow with non-uniform velocity distribution is analysed. Viscous effects which are the cause of damping or growth are important in the wall layer near the bottom and also at the critical depth, which is present when the wave speed is between

zero and the fluid velocity at the free surface. The basic equations for the problem are given. Exchange of momentum and energy between wave and primary flow is discussed. Illustrations of the theory are given for long waves over running flow and for the flow along a ship advancing in a wavy sea. In these examples a negative curvature of the mean velocity profile is shown to have a stabilizing effect. (Knapp-USGS) W70-02626

PARTICULATE ALUMINUM AND IRON IN SEA WATER OFF THE SOUTHEASTERN COAST OF THE UNITED STATES, Duke Univ., Beaufort, N.C. Marine Lab. For primary bibliographic entry see Field 02K. W70-02630

TEMPERATURE FLUCTUATIONS SPECTRA IN THE SEA SURFACE LAYER (RUSSIAN), S. I. Krylov.

English summary. Izvestiya Akademii Nauk, SSSR, Seriya Fizika Atmosfery i Okeana, Vol 5, No 9, p 921-928, Sept 1969. 5 fig, 2 tab, 4 ref.

Descriptors: *Water temperature, *Fluctuation, *Sea water, *Estuaries, Instrumentation, Air temperature, Mathematical studies, Temperature. Identifiers: *Baltic Sea, *Water temperature fluctuations.

Temperature fluctuations in sea surface layers were investigated using temperature data recorded in the Baltic Sea, 1963-1967. Temperature fluctuations are characterized by the periods of 2 to 4 min, with temperature differences up to 2.0-2.5 deg C in 3.0 to 3.5-minute periods. (Gabriel-USGS) W70-02647

A FALLING-PARTICLE CURRENT METER, Columbia Univ., Dobbs Ferry, N.Y. Hudson Labs. For primary bibliographic entry see Field 07B. W70-02670

DISCHARGE OF SEWAGE EFFLUENT FROM A LINE SOURCE INTO A STRATIFIED OCEAN, California Inst. of Tech., Pasadena. Dept. of Civil Engineering. For primary bibliographic entry see Field 05D. W70-02714

CURRENT STUDY IN THE NEUSE RIVER AND ESTUARY OF NORTH CAROLINA, North Carolina Univ., Morehead City. Inst. of Marine Sciences. William J. Woods.

Available from the Clearinghouse as PB-188 905, \$3.00 in paper copy, \$0.65 in microfiche. Report No 13, Water Resources Research Institute of the University of North Carolina, Dec 1969. 35 p, 4 tab, 17 fig, 10 ref. OWRR Project A-020-NC.

Descriptors: *Estuaries, *Currents, Inflow, Streamflow.

Identifiers: *Neuse river, Current study, *Tidal prism.

Two Rhodamine B dye insertions were made in the lower 59 km of the Neuse River Estuary during the summer of 1967. Movement of the dye was followed with Turner Model 111 Fluorometers. Time-of-travel estimates of the dye patch were made for the two insertions. Under meteorological conditions existing at the time of the study a mean flushing time of six days and a maximum flushing time of 7.4 days is estimated for the lower 28.2 km of the Neuse River Estuary. A mean flushing time of 12.3 days and a maximum flushing time of 19.25 days is estimated for the 30.8 km of the river immediately below New Bern, North Carolina. A maximum flushing time of 26 to 27 days is estimated for the lower 59 km of the Neuse River Estuary for conditions existing during the summer of 1967. Further measurements are suggested. (Howells-Univ of North Carolina)

Field 02—WATER CYCLE

Group 2L—Estuaries

W70-02760

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

VALUE OF DESALTED WATER FOR IRRIGATION,

Bureau of Reclamation, Denver, Colo.; and Bureau of Reclamation, Boulder City, Nev.
For primary bibliographic entry see Field 03C.
W70-02632

STUDY OF A DESIGN-OPTIMIZATION PROCEDURE FOR ION-EXCHANGE AND ADSORPTION COLUMNS,

California Univ., Berkeley.
S. Pancharatnam, G. Klein, and T. Vermeulen.
Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for \$1.25 per copy. Office of Saline Water Research and Development Progress Report No 477, Sept 1969. 113 p. OSW Grant 14-1-0001-1698.

Descriptors: *Desalination process, *Ion-exchange, *Sorption.

Identifiers: *Sorption processes, *Fixed-bed, *Regeneration cycle, Process-design.

Optimal design of large-scale ion-exchange systems involves predictions of the effluent concentration under repeated cycles of incomplete exhaustion-regeneration. This report describes the exploratory study of a way to make such predictions, and of their use in optimization procedures. Controllable variables for a specified process are column dimensions, flow rates and running times which give rise to dimensionless length-time values. Output results are the recoveries and purities of desired components in effluent fractions and consequent cost functions. Graphs prepared as described in this report determine how optimally to design or operate a column. A computer program is described which utilizes a 'ridge-climbing' technique to find the economically optimum design. Input to the program includes cost factors for resin, regenerant, apparatus, and power, and correlation constants obtained from a mass-transfer model of the system. Output comprises the optimum combination of bed height and exhaustion flow rate. (Filban-Office of Saline Water)

W70-02687

AXIAL-DISPERSION CONSTANT-PATTERN KINETICS OF ION-EXCHANGE AND ADSORPTION COLUMNS,

California Univ., Berkeley.
Robert E. Quilici, and Theodore Vermeulen.
Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for \$1.00 per copy. Office of Saline Water Research and Development Progress Report No 476, Sept 1969. 95 p. OSW Grant 14-01-0001-1698.

Descriptors: *Desalination process, *Ion-exchange, *Adsorption.

Identifiers: *Adsorption processes, *Fixed-bed separation, Process design.

Engineering design of ion-exchange and adsorption columns for large-scale use has been hindered by the absence of precalculated breakthrough curves of a general nature, which should be available for rapid calculation of practical systems. As an adjunct to research on multicomponent ion exchange sponsored by the Office of Saline Water, attention is being given at the University of California to certain unsolved problems in two-component ion exchange and one-component adsorption in which the solutions are still needed for engineering purposes. Among such problems is the effect of 'lon-

itudinal mixing' or 'axial dispersion' in beds of packed spheres. At low flow rates or with large sorbent particles, axial dispersion may produce a spreading of the concentration breakthrough curves for fixed-bed separations in addition to the spreading given by the mass-transfer resistance alone. The combined effects of axial dispersion and mass transfer have been studied for four controlling exchange mechanisms or models -- external mass transfer, solid diffusion, pore diffusion, and reaction kinetics. Tabulated results of numerical solutions are given for the constant-pattern case, involving constant separation factors from $r=0$ to $r=0.7$, for dispersion/mass-transfer ratios beta from near zero to 10. (Filban-Office of Saline Water)

W70-02688

SALT WATER CORROSION CONTROL BY ENVIRONMENT MODIFICATION,

Dow Chemical Co., Freeport, Tex. Texas Div.
For primary bibliographic entry see Field 08G.
W70-02689

ULTRASONIC DETECTION OF CALCIUM SULFATE SCALE ON METAL SURFACES,

Midwest Research Inst., Kansas City, Mo.
For primary bibliographic entry see Field 08G.
W70-02690

SEA WATER CORROSION TEST PROGRAM,

Dow Chemical Company, Freeport, Tex.
For primary bibliographic entry see Field 08G.
W70-02691

EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION,

TRW Systems Group, Redondo Beach, Calif.
For primary bibliographic entry see Field 08G.
W70-02692

DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER,

Westinghouse Electric Corp., Pittsburgh, Pa.
For primary bibliographic entry see Field 08G.
W70-02693

PLANNING FOR POWER - A LOOK AT TOMORROWS STATION SIZES,

Ebasco Services, Inc.
For primary bibliographic entry see Field 08C.
W70-02740

EVALUATION OF TITANIUM-PLATED STEEL IN A CHLORIDE ENVIRONMENT,

Solar, San Diego, Calif.
For primary bibliographic entry see Field 08G.
W70-02741

DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER,

Westinghouse Electric Corp., Pittsburgh, Pa.
For primary bibliographic entry see Field 08G.
W70-02742

THE DETERMINATION OF THE ENGINEERING THERMO-PHYSICAL PROPERTIES OF SOLUTIONS CONTAINING DISSOLVED SOLIDS,

Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 02K.
W70-02749

3B. Water Yield Improvement

DESERTS; THE PROBLEM OF WATER IN ARID LANDS,
London Univ. (England). Inst. of Education.
For primary bibliographic entry see Field 02A.
W70-02561

SUITABILITY OF THE UPPER COLORADO RIVER BASIN FOR PRECIPITATION MANAGEMENT,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Hiroshi Nakamichi, and Hubert J. Morel-Seytoux.
Colorado State University Hydrology Paper No 36, Oct 1969. 62 p, 12 fig, 8 tab, 58 ref, 2 append. Contract No BR 14-06-D-6597 (Bur of Reclam).

Descriptors: *Precipitation (Atmospheric), *Management, *Colorado River Basin, *Cloud seeding, Demonstration watersheds, Research and development, Statistical methods, Hydrologic aspects, Runoff forecasting, Hydrograph analysis, Seasonal.

Identifiers: *Precipitation management, Pilot program, Suitability criteria, Upper Colorado Basin.

Watershed suitability for weather modification over the entire Upper Colorado River Basin is discussed from the hydrologic standpoint. Determination of watershed or groups of watersheds for precipitation management programs was a primary objective of the study, particularly in the San Juan Mountains and the upper part of the Colorado basin. A relationship between precipitation and spring runoff with greater than 0.90 correlation coefficient was obtained for 365 sets of gaged subbasins by applying a multiple linear regression analysis, the independent variables being winter and spring precipitation. Assuming a uniform 10% increase in winter precipitation on the upper Colorado River basin, calculations show that three years of operations are needed for evaluation in that basin versus six years in the San Juan Mountains. (Lang-USGS)
W70-02622

WATER IN THE KAHUKU AREA, OAHU, HAWAII,

Geological Survey, Washington, D.C.
K. J. Takasaki, and Santos Valenciano.
Geol Surv Water-Supply Paper 1874, 1969. 59 p, 29 fig, 1 plate, 7 tab, 21 ref.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Hawaii, Aquifers, Basalts, Water levels, Water wells, Hydrogeology, Hydrologic data, Data collections, Water quality, Water yield, Streamflow, Springs, Infiltration, Rainfall, Climates, Topography.
Identifiers: *Kahuku (Hawaii), Oahu.

The Kahuku area of Oahu, Hawaii comprises the north end of the Koolau Range and its bordering coastal plain. A 2 1/2-mile-wide dike zone of parallel and subparallel dikes along the crest is the remnant of the fissure zone of eruption. Outcrops are mostly permeable lava flows of the Koolau Volcanic Series, which are intruded by dikes inside the dike zone and are free of dikes outside it. The lava flows constitute main aquifers, and water bodies in them are called dike water inside the dike zone and basal water outside it. Basal water occurs on either side of the dike zone. The quality of dike water is excellent except near the north end, where it is slightly contaminated by infiltration of irrigation water that contains as much as 1,200 mg/l chloride. The major contaminant, however, is sea water. In the Kahuku subarea--where pumping from the basal-water body is greatest--sea-water contamination is a major concern. Natural contamination by encroaching sea water extends more than 2 miles inland in the Waimea-Kawela subarea and generally precludes development of large quantities of basal water. At low altitudes where the perennial flow is small, all streams are intermittent

Conservation in Industry—Group 3E

except Kaluanui and Kamananui. Streamflow cannot be economically developed and is not a reliable source of water supply. Average rainfall is about 240 mgd. Groundwater flow is estimated to be 85 mgd. The most promising areas for developing basal water are in the Hauala and Laie subareas. The development of dike water is promising in the Waimea-Kawela subarea. (Knapp-USGS) W70-02623

RATE AND DIRECTION OF GROUNDWATER CIRCULATION IN CLOSE SPACED BEDROCK AND GRAVEL WELLS UNDER NON-SYNCHRONOUS PUMPING TIME AND RATES, Connecticut Univ., Storrs. Inst. of Water Resources.

For primary bibliographic entry see Field 04B. W70-02735

3C. Use of Water of Impaired Quality

SALT-WATER ENCRUSTATION INTO AQUIFERS.

For primary bibliographic entry see Field 02L. W70-02484

PLANNING AND PROVIDING AN ADEQUATE SUPPLY OF WATER FOR ORANGE COUNTY, CALIFORNIA,

Orange County Water District, Santa Ana, Calif. For primary bibliographic entry see Field 02L. W70-02487

THE CHALLENGE OF WATER MANAGEMENT: ORANGE COUNTY WATER DISTRICT, CALIFORNIA,

Orange County Water District, Santa Ana, Calif. For primary bibliographic entry see Field 02L. W70-02489

VALUE OF DESALTED WATER FOR IRRIGATION,

Bureau of Reclamation, Denver, Colo.; and Bureau of Reclamation, Boulder City, Nev. E. S. Krouse, J. P. Wagner, W. A. Fernelius, John T. Maletic, and Harold L. Parkinson. Available from Superintendent of Documents, US Government Printing Office, Wash DC, 20402 - Price \$2.00. Office Saline Water Research and Development Progress Report No 489, Oct 1969. 158 p, 10 fig, 5 dwg, 69 tab, 28 ref.

Descriptors: *Desalination processes, *Water costs, *Irrigation, *Water quality, Irrigated land, Land reclamation, Electrodialysis, Flash distillation, Desalination plants, Brine disposal, Boron, Cost analysis, Waste disposal.

Identifiers: Sodium adsorption ratio, Multistage flash distillation.

The water quality benefits associated with desalinated irrigation water at concentrations of 400, 900, and 1,500 parts per million were determined for three irrigated areas in Arizona and California. Desalination for irrigation is most favorable in areas producing crops that yield high net farm incomes under yearlong growing seasons. Irrigation developments of about 10,000 acres require large-scale multistage flash distillation plants utilizing nuclear energy, but electrodialysis is more favorable for smaller irrigated areas. The sodium adsorption ratio and boron content of product water must be reduced to assure sustained productivity. Benefit-cost analysis indicates that 400 ppm (TDS) is the optimum product water quality. Unit water cost was least in larger plants. A serious problem associated with inland desalting is brine disposal. (Carstens-USGS) W70-02632

OPTIMIZING SALVAGEABLE WATER RESOURCES IN A SEMI-ARID INLAND BASIN, Arizona Univ., Tucson.

W. Clyma, W. G. Matlock, W. J. McConnell, H. K. Qashu, and S. D. Resnick.

Available from the Clearinghouse as PB-188 933, \$3.00 in paper copy, \$0.65 in microfiche. Project Completion Report, Arizona Water Resources Center, Aug 1969. 45 p, 5 tab, 9 fig, 10 ref. OWRR Project A-011-ARIZ.

Descriptors: *Water reuse, *Natural recharge, Treatment, Water management (Applied), Arid lands.

This investigation characterizes salvageable water resources in the semi-arid Tucson basin and evaluates appropriate treatment and control methods and management procedures for reuse of these salvageable waters. A preliminary inventory of salvageable water resources in the Tucson basin indicated a conservatively estimated annual total of 30,000 acre-feet available from municipal, industrial, and urban runoff sources. Little was known of the quality of urban runoff in this semi-arid environment, and efforts were directed toward exploratory sampling and analysis as indicators of potential problem areas in runoff quality. A groundwater recharge investigation at the Rillito Creek recharge site near Tucson produced a mathematical model which can be applied to alternative management schemes in the utilization or storage of salvage waters. Initial formulation of management alternatives appeared to require an improved system framework defining community objectives and criteria for salvaged water allocation. (DeCook-Arizona) W70-02745

3D. Conservation in Domestic and Municipal Use

CONSERVATION OF NATURAL RESOURCES. Wis Stat Ann secs 23.095, 23.11, 23.26 (1964), as amended, (Supp 1969), 23.093 (Supp 1969).

Descriptors: *Wisconsin, *Natural resources, *Administrative agencies, *Coordination, Piscicides, Fish control agents, Conservation, Parks, Forests, Forest management, Fish hatcheries, Access routes, Land use, Road construction, Soil management, Wildlife management, Administration, Water management (Applied), Legislation, Carp, Investigations.

The Conservation Commission is authorized to contract with public or private agencies for research and development of a toxic material for the control and eradication of carp in state waters. The Commission is further authorized to establish and maintain state fish hatcheries and care for and protect all state forests. The Commission may acquire needed access routes to lands under its control which are surrounded by privately owned lands. The Commission shall periodically report to the Governor on its activities and on the results of its investigations. Such reports shall be accompanied by appropriate recommendations for the conservation and preservation of the state's natural resources. A Natural Resources Committee of state agencies is created to coordinate conservation programs of the several participating agencies. The Committee shall investigate and make recommendations to the state agencies and to the legislature concerning soils, waters, fish, forests, wildlife, and other natural resources of the state. It is a misdemeanor to unreasonably waste or maliciously impair or destroy any natural resource of the state. (Dearing-Florida) W70-02587

CONSERVATION ACT. Wis Stat Ann sec 23.09 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Water resources development, *Conservation, *Fish management, Recreation, Water conservation, Administrative agencies, Regulation, Local governments, Interagency cooperation, Project planning, Surveys, Publications, Fish conservation, Watershed management, Forest management, Fish hatcheries, Fish stocking, Drowning, Access routes, Condemnation, Navigable waters, Financing, Scenic easement, Leases, Beaches.

Identifiers: Water rescue.

The Conservation Commission may promulgate and publish rules and regulations, conduct studies, disseminate information, and provide services to residents for the furtherance of forest, fish, game, and water conservation. The Commission is further empowered to: (1) acquire easements and other property interests in lands and waters by purchase, gift, condemnation, lease, or agreement; (2) grant leases and easements to properties under its management in the interest of conservation; (3) establish and maintain fish refuges and hatcheries, and to propagate and sell fish for stocking waters of the state; (4) maintain state forests to protect watersheds; (5) develop a program for classifying lakes and streams by use; (6) assist the county boards in condemnation of rights-of-way to any navigable stream, lake, or other waters for public use; (7) provide public fishing grounds; (8) provide matching funds to local governments for the acquisition of public access routes to any navigable waters and for the development of county recreational facilities including beaches; and (9) assist local governments in programs for the rescue of persons lost or in danger in state forests or waters and in the recovery of victims of drownings. (Dearing-Florida) W70-02816

3E. Conservation in Industry

WATER FOR INDUSTRIAL DEVELOPMENT IN COVINGTON, JEFFERSON DAVIS, LAMAR, LAWRENCE, MARION, AND WALTHALL COUNTIES, MISSISSIPPI.

Geological Survey, Jackson, Miss. Water Resources Div.

R. E. Taylor, C. P. Humphreys, Jr., and D. E. Shattles.

Geol Surv - Mississippi Research and Development Center Cooperative Rep, 1968. 114 p, 56 fig, 19 tab, 18 ref, 3 append.

Descriptors: *Water resources, *Mississippi, Groundwater, Surface waters, Streamflow, Water wells, Water quality, Hydrogeology, Hydrologic data, Data collections, Water resources development, Industrial water, Aquifers.

Identifiers: *Lamar County, Covington County, Jefferson Davis County, Marion County, Walthall County, Lawrence County.

Covington, Jefferson Davis, Lamar, Lawrence, Marion, and Walthall Counties in south-central Mississippi possess surface and groundwater in quantities capable of supporting large industrial and municipal developments. The area uses an aggregate of 9.7 mgd, and present industrial and municipal supplies are obtained predominantly from groundwater. However, more than 7 times this daily rate of withdrawal has been allocated from the Pearl River alone for a new industry. The largest single source of fresh water in the area is the Pearl River. Even during a 10-year drought, natural flow of the Pearl increases from 160 mgd at the northern Lawrence County line to 700 mgd at the southern Marion County line. This 540 mgd pickup in flow, as the river passes through the study area, is furnished mostly by tributary streams which are among the highest yielding streams in Mississippi. Water in the streams is of good quality, even though some wastes are discharged to the streams. Sedimentary aquifers of Eocene to Holocene age contain the fresh groundwater. Aquifers of Miocene age are available throughout the 6 counties. These aquifers not only supply present industries.

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3E—Conservation in Industry

trial and municipal water demands but offer the greatest water supply potential in the area. Transmissibility values calculated for Miocene aquifers ranged from 2,400 to 400,000 gpd per foot, and for the Pearl River alluvium the value was 35,000 gpd per foot. Specific capacities of wells range from less than 1 to 70 gpm per foot of drawdown. The groundwater is of generally good quality and requires little or no treatment for most uses. (Knapp-USGS)
W70-02478

3F. Conservation in Agriculture

INFILTRATION OF WATER INTO NONUNIFORM SOIL,

Agricultural Research Service, Phoenix, Ariz.
Water Conservation Lab.

For primary bibliographic entry see Field 02G.
W70-02447

ALFALFA WATER TABLE INVESTIGATIONS,

Agricultural Research Service, Reno, Nev. Soil and

Water Conservation Research Div.

For primary bibliographic entry see Field 02I.

W70-02450

THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA,

Nebraska Univ., Lincoln. Dept. of Economics.

Theodore Roesler, F. Charles Lamphear, and M.

David Beveridge.

Nebr Econ and Bus Rep No 4, Nebr Univ, Sept

1968. 59 p, 36 tab, 7 chart, 3 append.

Descriptors: *Irrigation, *Economics, *Kansas,
*Input-output analysis, *Economic impact, Mathematical models, Simulation analysis, Operations research, Systems analysis, Cost analysis, Agriculture, Benefits.

Identifiers: *Irrigation economics.

The economic effects of irrigation on the economy of Nebraska were studied by input-output analysis. Nebraska is one of the West North Central states. With its 77,227 sq mi of area, it ranks fifteenth among the states in land area. It had a population of 1,411,000 in 1960, ranking 34th. Its per capita personal income in 1963 was \$2,312, 25th among the states and 94% of the U.S. average of \$2,449. The total induced by effect of irrigated agriculture in 1963 was \$157.0 million. Households show the biggest impact, experiencing increased income of over \$5,200. This includes not only the increased personal income of farmers but also increases in the personal incomes of all persons engaged in supplying needed inputs to the Irrigated Crops Sector. The Real Estate and Trade Sectors experienced the next largest increases in transactions. (Knapp-USGS)
W70-02479

STUDIES IN THE TECHNIQUES OF FIELD TRIALS IN RANGE LANDS: I. SIZE, SHAPE AND ARRANGEMENT OF PLOTS,

Central Arid Zone Research Inst., Jodhpur (India).

M. B. Jain.

Annals of Arid Zone, Vol 6, No 2, p 129-137, 1967. 4 tab, 14 ref.

Descriptors: *On-site investigations, *Arid lands, *Range management, *Range grasses, *Research and development, Statistics, Ranges, Natural resources, Vegetation, Plant populations, Desert plants, Statistical models, Costs, Economics, Economic efficiency.

Identifiers: *India, *Experimental designs, Research efficiency, Experimental error, Experimental efficiency, Plots.

In India enormous livestock population and resulting overgrazing are causing rapid deterioration of range lands. Thus the livestock economy is causing

deterioration of natural resources and is becoming a drag on the whole economy. Improved range management is a must and necessarily depends on sound research. The author reports a study intended to improve research efficiency through better experimental plot design for Indian conditions. Trials were conducted on 'poor' condition range land in arid western Rajasthan, India. The author concludes that small plots require less experimental area (hence less natural variation) and are most economical from the standpoint of land. On the other hand, a large number of small plots with a large proportion of border area is expensive from the standpoint of fencing and labor. For Indian conditions the author concludes that long term grazing studies should be conducted on plots large enough to meet year round requirements without causing deterioration of the range. Plot size would vary according to carrying capacity of different range lands. Plot shape has to be nearly square to minimize fencing costs. To reduce error the experimental area should be stratified on the basis of vegetative composition. The problem of decreased efficiency with increased size suggests confounded designs for factorial treatments, and incomplete blocks for varietal trials. The arrangement of plots should always be as compact as possible. (Crouse-Arizona)
W70-02551

STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE: III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GROWTH AND FORAGE PRODUCTION OF DHAMAN (CENCHRUS CILIARIS) AND SEWAN (LASIURUS SINDICUS) PASTURES IN THE ESTABLISHMENT YEAR,

Central Arid Zone Research Inst., Jodhpur (India). H. S. Daulay, A. K. Chakravarty, and G. N. Bhati.

Annals of Arid Zone, Vol 7, No 2, p 265-269, 1968. 7 tab, 1 fig, 6 ref.

Descriptors: *Legumes, *Arid lands, *Range management, *Revegetation, *Soil moisture, *Productivity, Water conservation, Ranges, Range grasses, Forages, Pasture management, Root zone, Costs, Economics, Grazing, Sands, Crop production, Seeds, Fertility.

Identifiers: *India, *Rajasthan, Intercropping.

In arid western Rajasthan 80% of the range land is in poor condition from over grazing and produces less than 300 kg. per hectare. Reseeding has proven difficult although of vital importance to the livestock industry. The authors report a one year study of the effect of mixing important range grasses - dhaman (*Cenchrus ciliaris*) and sewan (*Lasiusurus sindicus*) - with three common legumes, mung (*Phaseolus radiatus*), moth (*Phaseolus acutifolius*) and guar (*Cyamopsis tetragonoloba*). A split-plot design with 4 replications was run on sandy soil at Jodhpur. There were 7 treatment combinations at 3 fertility levels. Intercropping of dhaman and sewan with the legumes produced an increase in forage yield of 20 to 30% compared with grass alone. Under arid conditions best increases in yield were with moth and guar. Estimated increases in income during the first year were (Rs. 249.46) per hectare with moth and (Rs. 208.75) with mung. An additional benefit was soil moisture conservation when dhaman was mixed with legumes. At the end of the first season soil moisture under dhaman - legume mixtures was higher at the 25, 50, and 75 cm. depths. No such increase occurred with sewan mixtures. (Crouse-Arizona)
W70-02554

EXPRESSING IRRIGATION EFFICIENCY IN TERMS OF APPLICATION TIME, INTAKE AND WATER ADVANCE CONSTANTS,

Texas Water Rights Commission, Basin Hydrology Section; and Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.

Yu-Si Fok, and A. A. Bishop.

American Society of Agricultural Engineers, Transactions, Vol 12, No 4, p 438-442, 1969. 2 tab, 6 fig, 11 ref.

Descriptors: *Irrigation efficiency, *Irrigated land, *Consumptive use, *Arid lands, *Timing, Irrigation practices, Surface irrigation, Application methods, Water conservation, Agricultural engineering, Equations, Rates of application, Water reuse, Runoff.

Identifiers: *Water advance equation.

In arid and semiarid lands surface irrigation constitutes more than 75% of consumptive use of water. Therefore, an increase in irrigation efficiency of only 10 percent will result in saving a large amount of water for use elsewhere. Drawing on available literature, the authors develop mathematical and graphical expressions of irrigation efficiency in terms of application time, intake and water advance constants. Application efficiency is shown to be a dependent variable of the exponent of the intake and the water advance equations, and the ratio of intake time to water advance time. Proper use of these three variables can result in higher application efficiency. In practice, however, only the time ratio is easily manageable. Therefore, for each farm the length of irrigation run should be designed to achieve a high time ratio. (Crouse-Arizona)
W70-02556

THE EFFECT OF GYPSUM ON THE WATER STORAGE IN A SANDY LOAM SOIL UNDER AN IRRIGATED PERENNIAL PASTURE,

Commonwealth Scientific and Industrial Research Organization, Riverina (Australia). Riverina Lab.

For primary bibliographic entry see Field 02G.

W70-02557

IRRIGATION IN ARID LANDS,

Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Irrigation Research Lab.

E. R. Hoare.

Institution of Agricultural Engineers, Journal and Proceedings, Vol 23, No 1, p 29-33, 1967. 4 tab, 2 fig.

Descriptors: *Arid lands, *Irrigation, *Evaporation, *Environmental effects, *Productivity, Irrigation systems, Rainfall, Climatic zones, Crop production, Human populations, Semiarid climates, Irrigation practices, Effective precipitation, Topography, Salinity, Fertilizers, Technology, Solar radiation, Agriculture, Irrigation efficiency, History.

Identifiers: *Australia, *Western U.S., *Pakistan, *India, *China, England.

This paper is the published form of a lecture given by the author in memory of Mr. Jack Wright, an English irrigation authority who designed, manufactured, and installed irrigation systems in many arid lands of the world. There is a brief review of the 4,000-year history of irrigation in arid lands of the Ancient World and of meteorological and topographic causes of aridity. The author compares a moderate rainfall zone in England with a semiarid zone of Australia to illustrate that aridity is often the result of a combination of high evaporative potential and relatively low rainfall - not just sparse rainfall. Because arid lands usually occur in areas with high levels of sunshine, application of irrigation water on suitable soils can result in high crop yields or even several crops per year. The need for sufficient water and adequate drainage to prevent salinity is covered briefly. The author estimates some 400 million acres are irrigated around the world, supporting about 400 million people at present. With increased fertilizers and technology, this area might support between 800 and 1200 million people. Unfortunately, potential for increasing the actual area under irrigation is low in precisely those areas where excess population is most critical: Pakistan, India and China. (Crouse-Arizona)
W70-02559

THE MAJARDAH SCHEME,

Long Island Univ., Greenvale, N.Y. C. W. Post Coll.

Robert S. Harrison.

WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

Control of Water on the Surface—Group 4A

Focus, Vol 19, No 5, p 8-11, Jan 1969. map.

Descriptors: *Semiarid climates, *Soil conservation, *Irrigation, *Land tenure, *Agriculture, Terracing, Erosion control, Reforestation, Productivity, Economic impact, Income, Irrigated land, Irrigation programs, Multi-purpose projects, Land reclamation, Drainage, Drainage systems, Salinity, Flood control, Wheat, Vegetable crops, Fruit crops, Land use, Social impact.
Identifiers: *Tunisia, *Mediterranean climate, *Agricultural processing plants, *Majardah Basin, Resettlement.

In Tunisia the area with the best potential for large scale irrigation is the Majardah Basin. The scheme is based on a French plan based on Marshall Plan funds. After independence the plan, which originally emphasized irrigation, was revised to include conservation and changes in land use and tenure based on the agrarian reform law of 1958. The area extends over 741,000 acres of the valley north to the Mediterranean. The river is fed by winter rains typical of the semiarid Mediterranean climate. Storage reservoirs are necessary to conserve the irregular river flow. The soils are fertile alluvium which supported prosperous agriculture in Roman times. Lower valley soils are heavy and require drainage systems. The goal is to irrigate 176,000 acres by 1971. Three multipurpose dams store water, control flooding and dilute saline waters. The irrigation canal system and drainage systems are described briefly. Erosion problems in the drainage basin are being controlled by terracing and reforestation. Land use plans are converting cultivation from extensive grains to intensive high value crops for the Tunis and European markets. Land reform has limited holdings to 150 acres and vastly increased the number of land owners. Agricultural product processing plants are being established. Already there has been a large increase in productivity and per capita income. (Crouse-Arizona)
W70-02560

WATER REQUIREMENTS OF LAWNGRASS,
Nevada Agricultural Experiment Station, Reno; and Agricultural Research Service, Ames, Iowa. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02D.
W70-02562

SPRINKLER IRRIGATION SPRAY TEMPERATURES,
Agricultural Research Service, Kimberly, Idaho. Soil and Water Conservation Research Div.; and Agricultural Research Service, Kimberly, Idaho. Snake River Research Center.
C. H. Pair, J. L. Wright, and M. E. Jensen.
American Society of Agricultural Engineers, Transactions, Vol 12, No 3, p 314-315, 1969. 1 tab, 3 fig, 7 ref.

Descriptors: *Irrigation water, *Sprinkler irrigation, *Water temperature, *Temperature control, *Micrometeorology, Irrigation, Temperature, Soil temperature, Cooling, Idaho, Soil-water-plant relationships, Heating, Crop response, Drops (Fluids).
Identifiers: *Wet-bulb temperature, Snake River Valley.

Temperatures of irrigation water may vary from near zero to 90°C where the source is a hot spring. As more nuclear power plants are installed, streams into which waste water is discharged may also become heated. It is important to know what the water temperature is when it comes in contact with the crop or soil. Temperature can affect seed germination, growth, fruit developments, response to frost and crop-cooling operations. In theory droplets from sprinkler irrigation should approach the wet-bulb temperature of the air. The authors describe an experiment conducted in southern Idaho to test this theory. They found that near zero temperature of irrigation water increased to within 1.8°C of wet-bulb temperature and decreased from near boiling to within 3.4°C of wet-bulb temperature when applied by sprinkler. Heating of as much

as 8°C and cooling of approximately 75°C were recorded. There was little variation in temperature with distance from the sprinkler. (Crouse-Arizona)
W70-02563

MULTIPLE USE OF MEDITERRANEAN RANGE LANDS; NEW APPROACHES TO OLD PROBLEMS,

Techion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
Z. Naveh.

Annals of Arid Zone, Vol 7, No 2, p 163-177, 1968. 1 tab, 2 fig, 29 ref.

Descriptors: *Multiple purpose projects, *Semiarid climates, *Land use, *Range management, *Decision making, Recreation demand, Arid lands, Agriculture, Arable land, Natural resources, Vegetation, Reforestation, Brush control, Carrying capacity, Conservation, Grazing, Surveys, Ecology, Watershed management, Pine trees, Grasses, Shrubs, Goats, Forests, Optimum development plans, Pasture management.
Identifiers: *Israel, *Mediterranean climate.

In Israel and other arid and semiarid Mediterranean lands increasing populations have put great pressure on food supplies from arable lands. A new look at renewable natural resources of the much abused rangelands is in order. The author estimates that from 40 to 64% of the land area of these countries is in hilly wildlands unsuitable for tillage. The climate is typically Mediterranean with long, hot and very dry summers. These lands are generally overgrazed and eroded and yield low productivity. In recent years the trend has been to convert these lands to forestry and close them to grazing. Other areas have been taken over by unproductive but tenacious woody shrub species which in effect closes them to grazing. The author proposes a more flexible policy toward these wild lands which would permit utilization such as forestry, grazing, recreation, watershed management or possibly a combination of some or all of these. The decisions should be based on careful surveys of the site potential and local needs. Research is needed to provide a sound basis for dynamic programming of optimum land use. (Crouse-Arizona)
W70-02567

DETERMINATIONS OF LEAF AND FRUIT WATER POTENTIAL WITH A PRESSURE CHAMBER,

Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Irrigation Research Lab.
For primary bibliographic entry see Field 02I.
W70-02568

SOME EXPERIENCE IN THE DEVELOPMENT OF LAND IN THE NEW IRRIGATION ZONE IN THE GOLODNAYA STEPPE (RUSSIAN),

A. Ramazanov, G. E. Baturin, and V. D. Lazaridis.

Gidrotekhnika i Melioratsiya, No 9, p 40-49, Sept

1969. 3 fig, 9 tab, 2 ref.

Descriptors: *Land development, *Land reclamation, *Irrigation, *Deserts, Cotton, Crops, Drainage systems, Geology, Hydrogeology, Topography, Soils, Irrigation canals, Corn (Field), Soil moisture, Salinity, Water level fluctuations.
Identifiers: *USSR, Soviet Central Asia.

To identify the irrigation drainage systems and crops best suitable for land development in the Golodnaya Steppe, Soviet Central Asia, experimental drainage systems for growing rice, cotton, and grass were investigated using some selected steppe plots. Intensive irrigation of lands located in the southeastern part of Golodnaya Steppe leads to basic changes in the water and salinity regimes of the soil. Moreover, the present methods of reclamation, as conducted in the steppe, do not guarantee satisfactory reclamation of irrigated lands. (Gabriel-USGS)
W70-02648

FREE WATER FLOW TO ROWS OF WELLS (RUSSIAN),

Cairo Univ. (Egypt).

For primary bibliographic entry see Field 02F.
W70-02657

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

ANALYSIS OF INFILTRATION INTO DRAINING POROUS MEDIA,

Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

For primary bibliographic entry see Field 02G.
W70-02448

A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967,

Institute for Land and Water Management Research, Wageningen (Netherlands).

For primary bibliographic entry see Field 06B.
W70-02495

DRAINAGE RIGHTS.

R I Gen Laws Ann secs 46-20-1, 46-20-3 (1956).

Descriptors: *Rhode Island, *Drainage, *Drains, *Ditches, Legislation, Legal aspects, Drainage practices, Damages, Cities, Construction, Relative rights, Local governments, Administration, Decision making, Adjudication procedure, Administrative decisions.
Identifiers: *Drainage rights, Hearings.

Landowners desiring to drain their land but who are unable to obtain the consent of owners of land to be affected may petition their town council for power to drain their lands. The petition will set forth the course of the proposed drain and the names of the proprietors whose lands are to be affected thereby. The town council will hear the parties in interest and may appoint three disinterested parties to recommend the best drainage method and a fair damage award for the adversely affected party. The town council will make such orders based on the report as it deems lawful and right. (Keith-Florida)
W70-02515

CLAIMS AGAINST AND CONTRACTS WITH OTHER DISTRICTS AND MUNICIPAL CORPORATIONS EXERCISING DRAINAGE POWERS.

Ill Ann Stat ch 42, secs 11-1 thru 11-17 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Drainage systems, *Drainage districts, *Cost allocation, Legislation, Administration, Regulation, Drainage, Drainage programs, Drainage engineering, Drainage practices, Administrative agencies, Judicial decisions, Cost sharing, Operation and maintenance, Adjudication procedure, Cost-benefit analysis, Cost repayment.
Identifiers: Penalties.

Any drainage district may connect its drains or levees to the drains or levees of another district. When work done by one drainage district benefits another, the benefitted district is liable for the just proportion of the cost of the work. Claims between districts may be settled by written contract, but such contract must be approved by the court having jurisdiction over the districts. Procedures are provided for hearings to fix the proportionate share of costs when districts are unable to agree. Judgment may be for money damages relating directly

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

to the amount of annual benefits between the parties. The judgement also constitutes the measure of liability between the districts for repair, maintenance and operation of the work. Any two or more adjoining drainage districts may establish joint systems. (Moulder-Florida)
W70-02516

PETITION TO COURT FOR DRAINAGE AND APPOINTMENT OF COMMISSIONERS.

Pa Stat Ann tit 3, secs 721-736 (1963).

Descriptors: *Pennsylvania, *Drainage, *Surface drainage, *Land development, Agricultural engineering, Legislation, Legal aspects, Subsurface drainage, Surface waters, Drains, Damages, Regulation, Excavation, Maintenance, Overflow, Swamps, Marshes, Surveys, Costs, Estimated costs, Drainage effects, Controlled drainage, Groundwater, Relative rights.
Identifiers: *Drain construction, Public nuisance.

When landowners desire to improve their land for agricultural purposes by surface or subsurface drains and such drains must be extended over or under the land of others to be effectual, the land owners must present a petition to the court of quarter sessions of the county where the land is located. The court will appoint viewers to make a feasibility study of the proposed drains and to report to the court the estimated damages which will be caused by the construction of the drains. The report will be accompanied by a plot of the proposed drains. The court will not confirm the report until damages have been paid to the parties to be injured, and drain construction will not begin until confirmation of the report. The petitioner and his successors in interest must keep the drains in repair or have them closed. A similar procedure is provided to cover the situation where the joint and several owners of swamp land desire to have their land drained, but if such land is deemed a public nuisance by the examining commissioners, the townships in which it lies may be apportioned part of the drainage expense. (Keith-Florida)
W70-02520

CITIES' POWER OVER WATERCOURSES.

Pa Stat Ann tit 53, secs 38401-38409 (1957).

Descriptors: *Pennsylvania, *Cities, *Watercourses (Legal), Jurisdiction, Rivers, Streams, Dams, Dam construction, Federal Government, Water resources development, Sanitary engineering, Waste disposal, Local governments, Legislation, Banks, Bank protection, Channels, Channel improvement, Beds, Confined water, Damages, Eminent domain, Condemnation, Navigable waters, Water sources, Water supply.

Cities may by ordinance establish the lines of banks, change channels, beds, and mouths of watercourses through lands or waters in or adjacent to the city. Cities may also crib, wall, confine, pave, inclose, prevent and remove obstructions, or build dams. For such purposes the power of eminent domain may be exercised. Notice of any such action must be given, and viewers are appointed to assess damages. These provisions shall not apply to any watercourse used by any municipality or water company as a source of supply. Whenever the consent of the federal government has been granted to a city to construct a dam in a public navigable river or stream for improving sanitary conditions, such city may take private property for that purpose. (Smith-Florida)
W70-02524

CITIES OF THE SECOND CLASS: POWERS RELATING TO LEVEES, FERRIES, WHARVES, CHANNELS, PIERS, AND INFLUENT PIPES.

Pa Stat Ann tit 53, sec 23138, 23139, 23155 (1957).

Descriptors: *Pennsylvania, *Cities, *Water supply, *Piers, Pipelines, Pumped storage, Reservoir operation, Reservoir storage, Water storage, Water tanks, Water wells, Water works, Influent streams, Engineering structures, Structures, Aqueducts, Pipes, Transportation, Conveyance structures, Wells, Legislation, State governments, Levees, Navigable waters, Channel improvement, Docks.

Identifiers: *Ferries.

Cities of the second class in Pennsylvania shall have the general powers necessary to: (1) provide for the construction and maintenance of levees and ferries within the city limits; (2) erect and regulate wharves on navigable waters adjacent to the city; (3) establish wharf and dock lines; (4) establish and change the channels of watercourses, and to wall and cover them; (5) establish and regulate public wells, cisterns, aqueducts, and reservoirs of water, and to fill the same; and (6) lay influent pipes of water works out into the bed of adjacent rivers, and to build a pier, for the purpose of procuring a pure water supply. Piers and influent pipes when laid must not obstruct navigation. (Marsee-Florida)
W70-02525

INTERFERENCE WITH DRAINAGE FACILITIES.

Pa Stat Ann tit 53, sec 57067 (1957).

Descriptors: *Pennsylvania, *Drainage systems, *Obstruction to flow, *Permits, Drainage, Drainage practices, Local governments, Drainage programs, Outlets, Pipes, Sewers, Storm drains, Water control, Water sources, Drains, Ditches, Culverts, Legislation, Legal aspects.

No person shall interfere with any drainage facility in a township without first submitting plans to the town commissioners for their approval. The commissioners may hold public hearings, alter the plans, and may grant complete or conditional approval. No drainage facility shall be interfered with except in strict accordance with plans so approved. Said commissioners may enter upon any lands or enclosures and maintain and repair drains or ditches as necessary to carry water from streets or highways. Nothing contained herein shall restrict the normal duties and powers of the State Department of Highways, any county, or the Water and Power Resources Board. (Smith-Florida)
W70-02526

FLOOD CONTROL.

Pa Stat Ann tit 32, secs 651, 654, 658-665 (1967), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Flood control, *Floodproofing, *Flood protection, Flood routing, Channel improvement, Check structures, Dams, Dikes, Diversion, Drainage systems, Flood forecasting, Flow control, Levees, Bridges, Highways, Reservoirs, Recreation facilities, Warning systems, Eminent domain, State governments, Federal government, Administrative agencies, Water resources development, Legislation.

The Department of Forests and Waters is authorized to survey sections of the Susquehanna River and prepare plans for the widening, deepening, removal of obstructions, repair of walls or changing the channel in order to obviate flood dangers. The Water and Power Resources Board is empowered to make surveys and plans for a proposed flood control district to control, store, preserve, and regulate the flow of rivers and streams to diminish or eliminate floods. Official plans are effective and the flood control district is established when the Board completes suitable plans. In carrying out official plans the Board may improve or alter the channel of any river, install flood warning systems, fill up any abandoned water course, construct dams, levees, and other flood control works which regulate rivers' flow, construct bridges, con-

struct any other works needed for flood control. Lakes and reservoirs so constructed may be used for recreation. The Board may receive federal flood control aid. The Board shall have the power of eminent domain, and the power to authorize the federal government to acquire property or rights outside the Commonwealth at the Board's expense. (Smith-Florida)
W70-02531

UNITED STATES PROJECTS.

For primary bibliographic entry see Field 06E.
W70-02533

OBSTRUCTIONS NOT TO BE MADE OR ALTERED WITHOUT CONSENT.

Pa Stat Ann tit 32, secs 682-691 (1967).

Descriptors: *Pennsylvania, *Supervisory control (Power), *Dams, *Flood protection, Administrative agencies, Permits, Construction, Obstruction to flow, Highways, Bridges, Local governments, State governments, Flood control, Repairing, Legislation, Legal aspects, Regulation, Investigations.
Identifiers: Obstructions.

No person, corporation, municipality or county may construct any dam or other water obstruction or any addition thereto, or change and diminish the course or current of any body of water within the state unless authorized by the Water and Power Resources Board. Each application to the Board for such authorization shall be accompanied by complete maps and specifications of such water obstruction. The Board may impose restrictions upon a permit to construct or alter a water obstruction. The Board may investigate any dam or water obstruction now in existence, and may determine whether such structure is unsafe or in need of repair. The Board shall notify the owners of needed repairs or of the necessity of removal of any structure. This act extends to all types of water obstructions regardless of the date of construction. If the condition of the obstruction is so dangerous to public safety as to create an emergency, the obstruction may be removed or repaired without notice to the owner. The act shall not apply to private streams of a limited size. The act vests neither powers of eminent domain nor authority of other commissions in the Board. (Kelly-Florida)
W70-02534

PYMATUNING SWAMP DAM.

Pa Stat Ann tit 32, secs 762-773 (1967).

Descriptors: *Pennsylvania, *Dam, *Regulated flow, *Reservoirs, Construction, Alteration of flow, Condemnation, Area redevelopment, Recreation, Hunting, Fishing, Land use, Costs, Operation and maintenance, Management, Operations, Swamps, Drainage systems, Water supply, Water conservation, Legislation, Legal aspects, Regulation, Land development, Administrative agencies, Supervisory control (Powers).

The Department of Forests and Waters is hereby authorized to have a dam constructed and/or completed across the outlet of Pymatuning Swamp for the purpose of regulating water flow. The Department shall have plans and specifications prepared to construct the dam so as to conserve water, regulate the flow, and maintain as regular a flow as possible throughout the year. The reservoir and adjacent land acquired in connection with the project may be developed and used for recreation, hunting, fishing or game refuges. The Water and Power Resources Board is vested with complete authority concerning the use and development of the land and water within the project. The Department may use condemnation proceedings to acquire needed lands. The Department is authorized to obtain releases from landowners in Ohio whose property may be injured as a result of project construction. The Department may enter

WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

Control of Water on the Surface—Group 4A

agreements with persons or agencies in Ohio for removal or relocation of utility lines or roads. The Department may sell or lease lands, and sell timber or improvements on state lands where such transaction will be beneficial to the state. When the dam and reservoir are completed, the Department will be responsible for the maintenance and operation. (Kelly-Florida)
W70-02536

LOCATION AND IMPROVEMENT OF RIVERS AND STREAMS.

Pa Stat Ann tit 32, secs 807-811 (1967).

Descriptors: *Bank stabilization, *River training, *Pennsylvania, *River regulation, River beds, Streams, Dams, Impoundments, Boundaries (Property), River flow, Wildlife conservation, Water resources development, Bank erosion, Channel improvement, Stream stabilization, Legal aspects, Legislation, Administrative agencies, Regulated flow, Water policy, Stream improvement.

The Water and Power Resources Board of the Department of Forests and Waters is authorized to determine the course and define the location, width, and depth of any river or stream within the state, except the tidal waters of the Delaware River. The Board is hereby empowered to protect the bed and banks of any streams, build dams, retaining walls, and other structures for the purpose of regulating the flow of such streams or rivers, for the prevention of percolations from streams through holes in the beds or banks thereof, and for protection of wildlife and riparian owners. The Board shall record the location of a river or stream so fixed in the county deed records. The Board shall have the power to enter private lands for purposes of this act. Any damages sustained by any property owner, as a result of actions by the Board in fulfilling its statutory duties, shall be paid by the Department of Forests and Waters. (Kelly-Florida)
W70-02537

DELAWARE RIVER BRIDGES.

Pa Stat Ann tit 36, secs 3191, 3201, 3211, 3251, 3271, 3321, 3341, 3371 (1961).

Descriptors: *Pennsylvania, *Bridges, *Interstate rivers, *Interstate commissions, State governments, Governments, Interstate compacts, River basin commissions, Rivers, Streams, Delaware River, Delaware River Basin Commission, Eminent domain, Condemnation, Bridge construction, Parks, Public lands, Highway relocation, Road construction, Highways, New Jersey, New York, Legislation.

Whenever the Commonwealth shall acquire and maintain any toll bridge, the Board of Commissioners of Public Grounds and Buildings may lease to any adjacent borough or township, for public park purposes only, any lands acquired in connection with such bridge which are not required for highway purposes. The Department of Highways is authorized and directed to erect a toll bridge over the Allegheny River. In the construction of said bridge, the Department shall have all powers conferred with respect to relocation, widening or construction of highways, including eminent domain. 'Bridges' between Pennsylvania and New York are defined. The New Jersey Act for the protection of bridges over the Delaware River is hereby declared to be of force in this state. 'Bridges' between Pennsylvania and New Jersey are defined. Certain sums of money are appropriated for a commission to build and acquire toll bridges over the Delaware River in conjunction with a similar commission of New Jersey. Such commission is created to act as a joint commission with New Jersey commission and is authorized to determine the proper location of certain additional bridges. (Smith-Florida)
W70-02546

DELAWARE RIVER JOINT TOLL BRIDGE COMMISSION.

Pa Stat Ann tit 36, sec 3401 (1961), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *New Jersey, *Interstate commissions, *Bridges, Interstate compacts, Bridge construction, Eminent domain, Condemnation, Delaware River Basin Commission, Delaware River, Rivers, Road construction, Highways, State governments, Port authorities, Legislation, Interstate rivers, Operation and maintenance, Administrative agencies, Harbors.

The Governor is authorized to enter into a compact with the State of New Jersey to create the Delaware Joint Toll Bridge Commission. Said Commission shall administer, operate, and maintain all joint state-owned bridges across the Delaware River and shall investigate and prepare plans for new bridges over said river. Said Commission is empowered to conduct all its affairs according to law, acquire and dispose of property, exercise the power of eminent domain, erect certain new bridges, charge and collect fees and tolls, acquire and operate port and terminal facilities, including the dredging of ship channels and turning basins, and exercise all other powers reasonably necessary to effectuate its authorized purposes. 'Port and terminal facilities' are defined. The Commission is empowered to acquire, construct and operate bridges at specified locations, to replace existing bridges, to acquire by purchase or condemnation any existing ferry or bridge in connection with the construction of a new bridge, to build or improve any road or highway in connection with a bridge project, and to demolish or remove any bridge which is to be replaced. (Smith-Florida)
W70-02547

REGULATION OF DAM AND MILLWAY CONSTRUCTION AND OPERATION.

Iowa Code Ann secs 469.1 to 469.31 (1949), as amended, (Supp 1969).

Descriptors: *Iowa, *Permits, *Dam construction, *Dams, Administrative agencies, Legislation, State governments, Cities, Legal aspects, Electric power, Hydroelectric plants, River regulation, Regulation, Washouts, Navigable rivers, Streams, Navigation, Riparian rights, Eminent domain, Embankments, Water utilization, Industrial water, Water pollution control, Highways, Waterfalls.

No dam may be constructed, maintained, or operated in any navigable or meandered stream for any purpose, or in other streams for manufacturing or power purposes, nor may any water be taken from such streams for industrial purposes, unless the Iowa Natural Resources Council has granted a permit therefor under the procedures established herein. Where the water is to be used for manufacturing purposes other than power development, no permit may be issued until the Iowa Water Pollution Control Commission has certified its approval of the water's use. Permits must also be obtained where dams affect highways or state-owned lands. This act also provides for: (1) permit allowance criteria; (2) dam construction and operation regulation; (3) nuisance proceedings to abate dams violating the act; (4) condemnation of lands for dams; (5) the construction of embankments on the land of others for bank protection; (6) the right to utilize falls below dams; (7) revocation of permits; (8) permits for existing dams; and (9) the assessment of damages arising from embankment construction and condemnation. Cities and towns may by complying with this act construct dams. (Marsee-Florida)
W70-02570

POWERS, RIGHTS, AND PRIVILEGES OF RAILROAD CORPORATIONS TO CROSS WATERCOURSES.

Miss Code Ann secs 7723, 7742 (1956).

Descriptors: *Mississippi, *Railroads, *Bridges, *Bodies of water, Legislation, Navigable waters, Non-navigable waters, Bridge construction, Boats, Docks, Streams, Rivers, Operation and maintenance, Construction, Transportation, Navigation, Mechanical equipment, Legal aspects.

Except as limited, or otherwise prescribed by federal statute or regulations, railroad corporations have the authority to contract, maintain, or operate railroads under, over, or across any body of water which lies along its route; build and maintain bridges, landings and wharves; and operate any type of watercraft necessary in the conduct of its business. Whenever a navigable body of water is crossed by a bridge, a draw or swing sufficient to allow the passage of boats must be maintained. (Casey-Florida)
W70-02572

FLOOD CONTROL.

Miss Code Ann secs 4769-4771, 4773, 4774, 4776, 4782, 4789, 4790, 4792-4795, 4800, 4802, 4803, 4803-01, 4805-4808, 4810, 4815-4817, 4819, 4826-01 (1956).

Descriptors: *Mississippi, *Administrative agencies, *Flood control, *Project planning, Legislation, Administration, Federal government, State governments, Flood protection, Water management (Applied), Floodways, Conveyance structures, Projects, Federal project policy, Watershed management, Flood routing, Levees, Right-of-way, Engineering structures, Bypasses, Operation and maintenance, Maintenance costs, Operation costs, Highway relocation, Eminent domain.
Identifiers: *Flood control districts.

Flood control districts are established to participate in federal flood control projects at the local level. Petition requirements for establishing such districts are provided, as are the duties of the court-appointed examining engineer. The federal project plan is filed as the official plan of the district. The District Commissioners are given corporate powers. Commissioners are authorized to cooperate in the construction and maintenance of project works, to acquire necessary land, to relocate highways, and to exercise powers of eminent domain. Provisions are made for the enlargement and combination of districts and for cooperation between districts. Commissioners are empowered to obstruct watercourses and to provide for artificial bypasses for floodwaters. Preliminary and maintenance expenses may be financed by loans and ad valorem taxation of property within the districts. Districts continue after the completion of the official plan for the maintenance and protection of works constructed under the plan. (Doublerley-Florida)
W70-02573

FLOOD CONTROL.

Miss Code Ann secs 4769-4771, 4773, 4774, 4776, 4782, 4789, 4790 (1956).

Descriptors: *Flood control, *Administrative agencies, *Project planning, *Project purposes, Flood protection, Rivers and Harbors Act, Water management (Applied), Overflow, Floodways, Conveyance structures, Engineering structures, Federal government, State governments, Administration, Projects, Administrative costs, Engineers estimates, Estimated costs, Watershed management, Federal project policy, Programs, Tax, Costs, Tax rate, Highway relocation.
Identifiers: *Flood control districts.

The court of chancery has jurisdiction to establish flood control districts to cooperate with the federal government in the implementation of federal flood control projects. A majority of the county supervisors may petition the chancellor to establish a district. The federal flood control proposal, the necessity for improvements, their purpose, the area to be protected, and a proposed name must be included

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

in the petition. A court-appointed engineer makes a feasibility study, accurately describes the lands involved, reports on the extent of all required improvements and their cost, and files the plan of the chief of engineers of the War Department with the chancellor. After proper notice, a hearing is held on the petition. The chancellor's order may be appealed by an elector, property owner, or any other person affected. The district commissioners have corporate powers, and are to adopt an official plan for the district with approval of the chancellor. Preliminary expenses are paid by an ad valorem tax upon property within the district. The commissioners may assure the federal government that the county will bear the expense for necessary highway alterations. (Doublerley-Florida)
W70-02574

FLOOD CONTROL.

Miss Code Ann secs 4792-4795, 4800, 4802, 4803, 4803-01 (1956).

Descriptors: *Flood routing, *Floodways, *Highway relocation, *Projects, Flood control, Diversion structures, Drainage systems, Flood protection, Levees, Reservoirs, Reservoir operation, Watershed management, Floodproofing, Design flow, Right-of-way, Embankments, Sluice gates, Spillways, Pumping plants, Ditches, Channels, Conduits, Conveyance structures, Engineering structures.

Flood control districts are empowered to acquire property rights within or without the district to accomplish their purposes, and may bargain with land owners or settle claims for damages. They are empowered to cooperate with federal agencies in the construction and maintenance of necessary works and are to assure the federal government that works will be maintained, that highway relocations and damages will be supplied by the state, and that lands and easements will be provided. Commissioners have the power of eminent domain, using the same procedures as public utility condemnation procedures. The districts may cooperate with other districts within limits, and they may enlarge or combine with other districts upon petition to the chancellor. Commissioners may alter the official plan for works and improvements in accordance with changes in the original federal plan. Districts have the right to obstruct or dam any natural watercourse and to provide for artificial bypasses for flood waters so long as the water is returned to its natural watercourse. The power to construct bypasses is also granted to existing districts in protected levee areas. (Doublerley-Florida)
W70-02575

FLOOD CONTROL.

Miss Code Ann secs 4805-4808, 4810, 4815, 4816, 4817, 4819, 4826-01 (1956).

Descriptors: *Financing, *Government finance, *Loans, *Taxes, Costs, Interest, Interest rate, Administrative costs, Initial costs, Maintenance costs, Operating costs, Reimbursable costs, Cost repayment, Tax rate, Cost sharing, Maintenance, Repairing, Operation and maintenance, Operations, Legislation, Bench marks.

Flood control district commissioners may, with approval of the chancellor, borrow funds to cover preliminary expenses to be paid from district funds, or if no works are constructed, an ad valorem tax may be levied. The tax is assessed annually until preliminary expenses, including expenses for highways and acquisition of property rights, are paid. An annual ad valorem tax may also be levied for maintenance and repair of flood control works and improvements. Emergency loans may be made, to be repaid from the first maintenance taxes thereafter collected. Commissioners may borrow money to make necessary highway improvements and to purchase property rights and interests. Reimbursements made by the federal government may be used by the commissioners. Upon comple-

tion of the official plan, districts will continue to maintain the works constructed under the plan. Commissioners have the right to police the works, compel citizens to help protect the works in great emergencies, and to prevent damage by prohibiting persons, vehicles or livestock from passing over works. Removal of bench marks or other reference marks is a misdemeanor. (Doublerley-Florida)
W70-02576

THE LAW OF SURFACE WATER IN MISSOURI,

Lawrence O. Davis.
Mo L Rev, Vol 24, Nos 2, 3, p 137-165; 281-317, Apr, June 1959. 66 p.

Descriptors: *Missouri, *Surface waters, *Water law, *Legal aspects, Watercourses (Legal), Floodwater, Natural flow doctrine, Appropriation, Civil law, Reasonable use, Drainage districts, Levees, Legislation, Drainage, Surface drainage, Obstruction to flow, Alteration of flow, Terracing, Impoundments, Impounded waters, Judicial decisions, Railroads, Cities, Riddance (Legal aspects), Repulsion (Legal aspects).

Written in two installments, this article is broken into four major divisions. The first division discusses the distinguishing characteristics of surface water and watercourses, and devotes special attention to the status of floodwater as surface water. The second division deals with the law of surface water in general, with subdivisions including: (1) the civil law rule or natural flow theory; (2) the common law or common enemy rule; (3) the reasonable use rule; and (4) the civil law and common enemy rules in practice. The third major division covers the history of Missouri surface-water law. Lastly, the fourth division sets forth present Missouri surface-water law and discusses in subdivisions: (1) appropriation; (2) municipal corporations; (3) railroads; (4) drainage and levee districts; (5) statutory private drainage rights; (6) liability for the escape of water incidental to impounding; (7) blocking of water by a proprietor at his upper property line; (8) the privilege of the upper owner to alter flow; and (9) terracing for water management. (See also W70-02578 thru W70-02583). (Marsee-Florida)
W70-02577

THE LAW OF SURFACE WATER IN MISSOURI,

Lawrence O. Davis.
Mo L Rev, Vol 24, No 2, p 137-145, Apr 1959. 9 p.

Descriptors: *Missouri, *Watercourses (Legal), *Surface waters, *Surface runoff, Legal aspects, Judicial decisions, State governments, Artificial watercourses, Intermittent streams, Natural streams, Ephemeral streams, Streams, Running waters, Bogs, Fen, Marshes, Swamps, Surface drainage, Ditches, Drainage water, Floodwater, Water types, Flooding, Water law.

While it is obvious that the term surface water does not include percolating groundwater, surface water must also be distinguished from water in a natural watercourse. This is necessary because of the different treatment afforded each by Missouri courts. The usual approach to distinguishing between surface water and watercourses is a negative approach in that all waters not meeting the requirements of a natural watercourse are labeled as surface waters. The question is one of fact depending upon the physical situation. As typified by the Missouri cases discussed, the question is often close, especially as relates to drainways and sloughs. Paramount considerations in classifying a particular body of water are the source of the water, continuity of flow, the physical characteristics of the drainway, and the general lay of the land. As regards floodwater, Missouri treats all overflow as surface water whether or not such overflow remains contiguous with the main channel. There is one exception: where the overflow temporarily escapes from the stream and runs through a defined channel back into the main

body of water, it is still regarded as part of the watercourse. (See also W70-02577). (Marsee-Florida)
W70-02578

THE LAW OF SURFACE WATER IN MISSOURI,

Lawrence O. Davis.
Mo L Rev, Vol 24, No 2, p 145-154, Apr 1959. 10 p.

Descriptors: *Missouri, *Appropriation, *Riddance (Legal aspects), *Repulsion (Legal aspects), Surface waters, Legal aspects, Water law, Drainage, Drainage water, Surface drainage, Surface runoff, Reasonable use, Alteration to flow, Obstruction to flow, Relative rights, State governments, Judicial decisions, Prior appropriation, Artificial watercourses, Cities, Natural flow, Natural flow doctrine.

Relatively few cases deal with the appropriation of surface water; however, as a general rule a landowner has the absolute right to use the surface water on his land. Some jurisdictions qualify the rule by allowing appropriation only insofar as necessary to a reasonable use of the land. Determining liability to adjoining owners for the obstruction or repulsion of surface water is a more difficult matter. Three separate rules have developed to make such a determination: (1) the civil law rule makes liable a person who interferes with the natural flow of surface waters to another's detriment; (2) the common enemy rule gives each landowner unlimited privilege to drain or obstruct the surface water on his land; and (3) the reasonable use rule makes an owner liable only for unreasonable modifications to the natural flow. The civil law and common enemy rules have been criticized and have been modified in practice. The civil law rule has been held inapplicable to urban property, while the common enemy rule has been modified to prohibit the artificial discharge of water in a concentrated body upon lower land. Other minor exceptions are mentioned. (See also W70-02577). (Marsee-Florida)
W70-02579

THE LAW OF SURFACE WATER IN MISSOURI,

Lawrence O. Davis.
Mo L Rev, Vol 24, No 2, p 154-165, Apr 1959. 11 p.

Descriptors: *Missouri, *Judicial decisions, *Riddance (Legal aspects), *Repulsion (Legal aspects), Surface waters, Water law, Legal aspects, Drainage, Drainage water, Surface drainage, Surface runoff, Natural flow, Alteration of flow, Obstruction to flow, Railroads, Relative rights, State governments, Watercourses (Legal), Impoundments, Impounded waters, Reasonable use.

Since the case of *Abbott v Kansas City, St. J and C.B.R.R.*, 83 Mo 271 (1884), which adopted the common enemy rule, the theory of surface water law in Missouri has never been seriously questioned. Prior to that, however, there was confusion as to what rule Missouri would follow. Some cases indicated that the civil law rule was followed; others indicated that the common enemy rule was favored. This historical discussion places these older cases in proper perspective to avoid misunderstanding of their significance today. (See also W70-02577). (Marsee-Florida)
W70-02580

THE LAW OF SURFACE WATER IN MISSOURI,

Lawrence O. Davis.
Mo L Rev, Vol 24, No 3, p 281-283, June 1959. 3 p.

Descriptors: *Missouri, *Appropriation, *Repulsion (Legal aspects), *Surface waters, Legal aspects, Riddance (Legal aspects), Water rights.

WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

Control of Water on the Surface—Group 4A

Priorities, Beneficial use, Percolating water, Groundwater, Judicial decisions, State governments, Overflow, Flooding, Water law.

This second installment of a two-part article on the surface water law of Missouri deals with the application of the common enemy rule in Missouri. While not directly governed by the common enemy doctrine, the landowner's right to appropriate the surface water on his land is also discussed. The extent of such appropriation has never been directly decided in Missouri; however, inasmuch as the common enemy doctrine is presumably based on the theory that every proprietor has complete dominion over the soil, it would seem logical that the right to appropriate would be practically unlimited. Some jurisdictions have applied the same rules of appropriation to both surface water and water percolating through the ground in no definite channel. A Missouri case has regarded such percolating water as a part of the soil but nevertheless prohibited malicious interference by the proprietor with its flow. This case could be extended to prevent malicious appropriation of surface water if surface water and percolating water are to be treated alike. Overflow water of a stream is generally treated as surface water in Missouri for appropriation purposes. (See also W70-02577). (Marsee-Florida) W70-02581

THE LAW OF SURFACE WATER IN MISSOURI,
Lawrence O. Davis.
Mo L Rev, Vol 24, No 3, p 283-289, June 1959. 6 p.

Descriptors: *Missouri, *Cities, *Drainage districts, *Railroads, Surface waters, Legal aspects, Water law, Judicial decisions, Legislation, Municipal water, State governments, Levees, Repulsion (Legal aspects), Riddance (Legal aspects), Obstruction to flow, Alteration of flow, Drainage, Drainage water, Impoundments, Relative rights, Embankments, Roadbanks.
Identifiers: *Municipal corporations.

Because of its activity in street improvement and sewer construction, the municipal corporation is often involved in surface water litigation. Several cases are discussed as examples. Although it would appear that municipal corporations are favored due to their public nature, it may be that the liability of such corporation for the interference with the surface drainage is the same as that of a private individual. Much Missouri surface water litigation has resulted from railroad construction. An early case adopted the rule that a railroad must, if there is a watercourse nearby, provide openings through their roadbeds, and suitable ditches, so as to afford sufficient drainage. This idea has today been embodied in a Missouri statute. Considerable litigation has centered around the activities of statutorily created drainage and levee districts. The rights of landowners within such districts are governed by statute and contract. As to landowners outside the district, however, the district is a legal entity and treated much as an individual or political subdivision of the state. No special rules exist governing the common law rights of these districts. (See also W70-02577). (Marsee-Florida) W70-02582

THE LAW OF SURFACE WATER IN MISSOURI,
Lawrence O. Davis.
Mo L Rev, Vol 24, No 3, p 289-298, June 1959. 9 p.

Descriptors: *Missouri, *Repulsion (Legal aspects), *Riddance (Legal aspects), *Impounded waters, Surface waters, Drainage, Surface runoff, Obstruction to flow, Alteration of flow, Barriers, Diversion, Relative rights, Judicial decisions, Legal aspects, Legislation, Impoundments, Drainage districts, Levees, Embankments, Drainage water, Earth dams, Railroads, Cities, Farms, Water law.

After discussing some statutes relating to private drainage rights, this article deals with a landowner's liability in Missouri for impounded surface water which either escapes or backs up onto another's land. From three Missouri cases considered, it is concluded that there is no liability for the escape of impounded surface water unless the escape is in a concentrated volume, or is the natural result of the impoundment or unless negligence is involved. Where the lower owner causes water to back up onto an upper owner's land, Missouri cases indicate that the lower owner is not liable if he blocks the water on the property line, but is liable if he does so elsewhere. This result is criticized: Blocking water at the property line may have two effects: the water may form a pond behind the embankment on the higher land, or it may be diverted across the lands of a third party. Missouri courts have made no distinction between these situations as relates to the liability of the impounder. Blockage as relating to urban areas, farming areas, and drainage and levee districts is discussed. (See also W70-02577). (Marsee-Florida) W70-02583

PUBLIC LANDS AND SWAMPS - SALES - PUBLIC USE.

Wis Stat Ann secs 24.11 (3), 24.14, 24.145 (1964).

Descriptors: *Wisconsin, *Public rights, *Federal reclamation law, *Swamps, Public lands, Access routes, Contracts, Grants, Easements, Water rights, Mining, Mineralogy, Land reclamation, Patents, Federal-state water rights conflicts, State jurisdiction, Levees, Drains, Streams, Rivers, Ponds, Lakes.
Identifiers: *Public access, *Water-power rights.

Every contract, sale, or grant of public lands and waters shall reserve to the people the right of access for any purpose to such lands or streams, rivers, ponds, or navigable lakes bordered by such lands. There is further reserved all rights necessary to the full enjoyment by the people of such public lands and waters and all minerals therein. Such contract or conveyance is also subject to continued ownership by the state of all water-power rights and mineral removal rights on such lands. Any person who has purchased from the United States or entered any lands patented to this state as swamp and overflowed lands prior to the execution of such patents to the state, whose entry has been cancelled by the United States due to the subsequent patent to the state may purchase from the state such lands as were in the original patent from the United States at that original price. None of the swamp and overflow lands nor any proceeds from the sale of such lands are needed for the purpose of reclaiming such lands. These lands and the proceeds of their sale shall be made a part of the normal school fund. (Dearing-Florida) W70-02588

FLOOD PLAIN INFORMATION OF SCAUAQUADA CREEK, IN THE TOWNS OF CHEEKTOWAGA AND LANCASTER, ERIE COUNTY, NEW YORK.

Corps of Engineers, Buffalo, N.Y.

Prepared for Erie-Niagara Basin Regional Water Resources Planning and Development Board. Corps Engineers Flood Plain Report, May 1969. 67 p, 42 fig, 8 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *New York, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Cheektowaga (NY), Lancaster (NY), Erie County (NY), Standard project flood, Intermediate regional flood.

Flooding of Cheektowaga and Lancaster, Erie County, New York is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)

W70-02629

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN PENNSYLVANIA.

Corps of Engineers, Philadelphia, Pa. North Atlantic Div.

Corps Engineers Water Resources Development Report, Jan 1, 1969. 110 p, 2 fig, 63 photo, 1 plate, index.

Descriptors: *Water management (Applied), *Pennsylvania, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.

Identifiers: U.S. Army Corps of Engineers projects (Penn).

U.S. Army Corps of Engineers water resources development projects in Pennsylvania are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W70-02644

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN NEW YORK.

Corps of Engineers, New York. North Atlantic Div.

Corps Engineers Water Resources Development Report, Jan 1, 1969. 151 p, 7 fig, 2 plate, 77 photo, index.

Descriptors: *Water management (Applied), *New York, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.
Identifiers: U.S. Army Corps of Engineers projects (NY).

U.S. Army Corps of Engineers water resources development projects in New York are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W70-02645

SOME EXPERIENCE IN THE DEVELOPMENT OF LAND IN THE NEW IRRIGATION ZONE IN THE GOLODNAYA STEPPE (RUSSIAN).

For primary bibliographic entry see Field 03F.

W70-02648

CALCULATION OF SLOPE STABILITY OF RIVERS AND DRAINAGE CANALS (RUSSIAN).

For primary bibliographic entry see Field 02E.

W70-02658

FLOOD PLAIN INFORMATION OF CANADAIGUA OUTLET IN THE COUNTIES OF ONTARIO AND WAYNE, NEW YORK.

Corps of Engineers, Buffalo, N.Y.

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

Prepared for WA-ONT-YA Reg Water Resources Planning and Development Board. Corps Engineers Flood Plain Report, Dec 1968. 54 p, 18 fig, 11 plate, 13 tab.

Descriptors: *Floods, *Flood damage, *New York, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.

Identifiers: Canandaigua Lake (NY), Ontario (NY), Wayne (NY), Standard project flood, Intermediate regional flood.

Flooding of the Canandaigua Lake Outlet, Ontario and Wayne Counties, New York is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)

W70-02667

DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE SIMULATION OF FLAT LAND WATERSHED HYDRAULICS,

Iowa State Water Resources Research Inst., Ames.

For primary bibliographic entry see Field 02G.

W70-02676

ALKALI SACATON SEEDLINGS: GERMINATION AND SURVIVAL IN AN AGAR AND SOIL MEDIUM,

Forest Service (USDA), Albuquerque, N. Mex. Rocky Mountain Forest and Range Experiment Station.

Earl F. Aldon.

USDA Forest Serv Res Note RM-156, 1969. 3 p.

Descriptors: *Ranges, *Range management, *Germination, *Temperature, Range grasses, Grasses, Arid lands, Desert plants, Vegetation establishment, New Mexico.

Identifiers: *Ground cover, Range science.

Alkali sacaton seedling germination and survival is improved by: (1) an agar medium to provide moisture for germination, (2) mulch, and (3) water on the fifth day after planting in soils containing 7 percent moisture by weight.

W70-02685

WATER REPELLENT SOILS: A WORLDWIDE CONCERN IN MANAGEMENT OF SOIL AND VEGETATION,

Forest Service, (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.

L. F. DeBano.

Agricultural Science Review 7 (2): 11-18. Second quarter 1969.

Descriptors: *Soils, *Waterproofing, *Burning, *Soil fungi, Soil physical properties, Peat, Turf, Surfactants, Moisture availability, Erosion, Plant diseases, Organic compounds, Soil mechanics, Water conservation, California, Water harvesting, Watershed management.

Identifiers: *Water repellent soils, Wildfires, Wetting agents.

Water repellency affects the management of large areas throughout the world. Seemingly unrelated problems such as plant diseases, subsidence of peat bogs, and soil erosion may be caused by poor wettability in some situations. Organic substances produced by plants or micro-organisms can induce water repellency in soils. High soil temperatures may further intensify water repellency in areas burned by wildfires. Mechanical and chemical remedial treatments have been used to increase the wettability and productivity of these problem soils. Waterproofing soils artificially has been found beneficial for highway engineering and water harvesting purposes.

W70-02686

DESIGN OF A COMBINED SEWER FLUIDIC REGULATOR, THE DEVELOPMENT OF BASIC CONFIGURATIONS AND DESIGN CRITERIA FOR APPLICATIONS OF FLUIDS IN SEWER REGULATORS.

Bowles Engineering Corp., Silver Spring, Md.

Available from the Clearinghouse as PB-188 914, \$3.00 in paper copy, \$0.65 in microfiche. FWPCA Water Pollution Control Research Series, DAST-13, Oct, 1969. 137 p, 98 fig, 3 ref. FWPCA Program No 11024 DGZ.

Identifiers: *Combined sewers, Low cost, Low maintenance, *Fluidic, Regulator, *Variable diversion, No-moving-parts.

The objective of this program was to demonstrate feasibility, and to develop a workable configuration for a combined sewer Fluidic regulator, whose purpose is to minimize combined sewer discharge while protecting interceptor sewers from overloading during storm flows. A second objective was to develop design procedures and criteria for the general application of this concept to municipal sewer diversion requirements, including preliminary investigations of construction methods, costs, and maintenance requirements. A third objective was to establish a plan and location for an operational demonstration of the concept with a cooperating municipality. All objectives were successfully met. A generic Fluidic Regulator configuration was evolved which diverts 0 to 75% of the combined sewer flow away from the interceptor as a function of water level sensed in the interceptor sewer, or combined sewer, in either an analog or digital operational mode. Application design criteria were evolved for a range of small to medium sized municipal sewers, in terms of a few basic parameters. Projected installation costs are only slightly more than for conventional diversion structures; while the anticipated construction and maintenance requirements are simple and minimal. The City of Philadelphia was established as the demonstration site, and a demonstration unit should become operational in late 1970. Recommendations were made for experimental activity to improve regulation linearity; expand application size limit, and to better definitize construction methods and costs.

W70-02773

PREVENTION OF FLOOD DAMAGE.

Pa Stat Ann tit 53, secs 23169-23170 (1957).

Descriptors: *Pennsylvania, *Flood protection, *Cities, *Flood control, Control, Local governments, Water control, Flood routing, Channel improvement, Check structures, Diversion, Flood damage, Floodproofing, Flow control, Water policy, Legislation, Control systems, Rivers, Streams, Investigations.

Second class cities may provide for the cleansing, regulation and control of streams and rivers within their limits in order to prevent flood damage. Such cities may construct public works for flood prevention and may cooperate with other governmental units in such projects. This shall not restrict the jurisdiction of the Water Supply Commission. Such cities may make appropriations and expenditures for the purpose of investigating and examining the condition of such rivers and streams. (Smith-Florida)

W70-02821

WHARVES, DOCKS, AND FERRIES.

Pa Stat Ann tit 53, sec 14212-14217 (1957).

Descriptors: *Pennsylvania, *Bulkhead line, *Coastal structures, *Condemnation, Docks, Piers, Bulkheads, Local governments, Administrative agencies, Administrative decisions, Condemnation value, Cost repayment, Riparian rights, Compensation, Permits, Low water mark, Navigable rivers, Construction, Legislation.

Cities of the first class may purchase and hold all properties and improvements extending into the navigable streams in front of said cities and may remove, alter, or modify the location, dimensions, or character of same to further the commercial interests of said cities. Such action, however, shall be taken only pursuant to recommendations of the Board of Harbor Commissioners and duly enacted city ordinances. Prior to any such recommendation, the Board shall give due notice to the owners of the properties to be affected. Should the owners fail to commence the removal or reconstruction, said cities may condemn said properties and improvements upon compensating the owners. When an owner also owns the adjacent bulkhead or riparian rights, the condemnation shall only encompass the primary properties. The councils in said cities may revise and establish the line beyond which no wharf or pier may extend and establish the arbitrary low water line or bulkhead line. No license shall be granted under which a new wharf is to be built, or old wharf extended, unless afterwards there shall be a water surface between it and adjoining wharves of at least one hundred and fifty feet. (Schram-Florida)

W70-02822

WHARF LINES AT BRISTOL.

Pa Stat Ann tit 53, secs 49311-49313 (1966).

Descriptors: *Pennsylvania, *Docks, *Delaware River, *Bulkhead line, Bulkheads, Engineering structures, Piers, Rivers, Construction, Riparian rights, Riparian land, Banks, Legislation, Tidal waters, Legal aspects, Administrative agencies.

There is hereby established a wharf-line in the Delaware River at Bristol for the purpose of having a sufficient depth of water at low tide to float vessels. The burgess and council of Bristol are authorized to construct certain wharves or piers extending as far out as the wharf-line. Any owner of land fronting on the Delaware River may construct a wharf or pier to said wharf-line, subject to the authority of the Board of Wardens of the Port of Philadelphia. (Smith-Florida)

W70-02823

BIDS: RECONSTRUCTION OF DESTROYED BRIDGES.

Pa Stat Ann tit 16, sec 9305 (1956).

Descriptors: *Pennsylvania, *Bridges, *Bridge failure, *Bids, Contracts, Bridge construction, Transportation, Legislation, Governments, Costs, Cost allocation, Legal aspects.

Where delay in rebuilding will be of serious inconvenience to trade and travel, the county commissioners may reduce the time for advertisement to two weeks for bids to reconstruct destroyed bridges. (McDonough-Florida)

W70-02824

STREAM CLEARANCE, RECTIFICATION AND IMPROVEMENT.

Pa Stat Ann tit 32, secs 701-706 (1967).

Descriptors: *Channel improvements, *Pennsylvania, *Obstruction to flow, *Flood control, Mass wasting, Warning systems, Stream flow, Alteration of flow, Channels, Floods, Stream erosion, Stream-flow forecasting, Stream improvement, Dams, Lakes, Impoundments, Impounded waters, Legislation, Legal aspects, Administrative agencies, Contracts, Condemnation, Easements, Dam construction.

The Department of Forests and Waters may dredge and remove flood waste, deposits, flood water obstructions and debris from any stream and may restore flood damaged stream channels in all streams except the tidal waters of the Delaware River. The Department may construct and maintain dams, lakes, and other improvements to impound flood waters, provide recreational areas, and construct flood forecasting and warning stations.

WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

Effects on Water of Man's Non-Water Activities—Group 4C

The Department may lease or purchase equipment and materials for these projects with the approval of the Governor. The Department may further acquire all property or easements necessary for carrying out this act. The Department is authorized to use condemnation proceedings for the acquisition of property. The Department is authorized, with the Governor's approval, to enter into agreements with the federal government, state agencies, or local subdivisions, municipalities, and private persons and corporations. Work assigned by the Department must be let to the lowest bidder. (Kelly-Florida)
W70-02827

DAMS AND STORAGE RESERVOIR.

Pa Stat Ann tit 32, secs 815.46-815.49a5 (1967).

Descriptors: *Pennsylvania, *Dams, *Water conservation, *Delaware River, Dam construction, Costs, Financing, Water resources development, Interstate rivers, Administration, Interstate, Operation and maintenance, Management, Impoundments, Impounded waters, Water supply, Flow augmentation, Legal aspects, Interstate compacts, New Jersey, Reservoirs, Reservoir construction, Condemnation.

The state legislature hereby accepts a portion of the New Jersey law relating to the construction of dams and reservoirs and the payment of land damages, costs, and expenses on land acquired in New Jersey for purposes of a prior act. An interstate compact is hereby entered into for the construction of a dam across a certain section of the Delaware River between New Jersey and Pennsylvania. A reservoir shall be maintained above said dam for the purpose of impounding the waters of the Delaware to provide a supply of water for domestic, commercial, and industrial purposes. Such construction and maintenance shall be deemed to be a public project for benefits of both states. Land may be taken for construction of the dam or reservoir through condemnation proceedings. Detailed procedure for condemning and/or purchasing land is provided. Certain provisions of the Delaware River Compact are revoked insofar as they prohibit construction of dams and reservoirs across the Delaware River. New Jersey and Pennsylvania must concur on the location, size, and construction of any dam or reservoirs. (Kelly-Florida)
W70-02829

CONSERVATION AND CONTROL OF AQUATIC PLANTS AND FISH.

Wis Stat Ann secs 29.545, 29.571, 29.62, 29.623, 29.625, 29.626, 29.63 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Aquatic plants, *Fish control agents, *Regulation, Wild rice, Sago pondweed, Aquatic weed control, Administrative agencies, Harvesting, Fish hatcheries, Dam construction, Damsites, Flood control, Drainage effects, Water levels, Rough fish, Carp, Buffalo fishes, Suckers, Sport fish, Riparian land, Fish stocking, Gill nets, Trout, Permits.
Identifiers: *Wildlife refuge, *Trammel net, *Sturgeon, *Game preserve.

The removal of any aquatic plants from specified water bodies without authorization by the State Conservation Commission is prohibited. Written authorization may be given where the plants endanger public health, are not needed for propagation of fish or wildlife, or unreasonably impair property or esthetic values. A wildlife refuge is established on the Horicon Marsh. The refuge may include a fish hatchery which is to be supervised by the Commission. The Commission is authorized to construct and maintain dams to control the flood waters of Rock River and to restore the natural water levels of Horicon Marsh prior to its drainage. The Commission may remove all 'rough fish' from inland waters. It may also remove or permit the removal of any species of fish which it determines

to be detrimental to any state waters or to game fish in certain designated areas. Penalties are provided for persons who use nets to catch fish in inland waters, who fish without licenses, or who otherwise violate any provision of the statutes or any Commission order related to fishing. Double damages may be awarded against trespassers on lands bordering streams stocked from state fish hatcheries. (Dearing-Florida)
W70-02838

POWERS OF THE DEPARTMENT OF RESOURCE DEVELOPMENT.

Wis Stat Ann secs 31.01, 31.02 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Water levels, *Dams, *Drainage programs, Administrative agencies, Permits, Navigable waters, Bench marks, Gaging stations, Low flow, Water measurement, Dam construction, Locks, Fish passages, Fish stocking, Chutes, Floodgates, Spillways, Hoisting machinery, Piers, Drainage districts, Ditches, Water conservation, Irrigation programs, Water birds.
Identifiers: *Pisciculture, *Marine railway, *Dykes.

The Department of Resource Development is empowered to regulate the level and flow of all navigable waters and may erect bench marks to designate the maximum and minimum levels that may be maintained by any dam. It shall establish gaging stations upon navigable waters to determine their characteristics. The Department shall investigate and supervise the construction, operation, and maintenance of all dams in navigable waters. The Department shall have free access to any dam and may enter any property to investigate a waterway or the use of water from any lake or stream. The Department may require any dam to be furnished with log slides and chutes, locks, boat hoists, or other special equipment set forth in the statute. The Conservation Commission shall operate and maintain dams and dikes across drainage ditches and streams in drainage districts. (Dearing-Florida)
W70-02842

4B. Groundwater Management

FUTURE OF GROUND WATER IN AFRICAN SAHARA DESERT,

Alexandria Univ. (Egypt). Faculty of Engineering. For primary bibliographic entry see Field 02F.
W70-02452

SALT-WATER ENCROACHMENT INTO AQUIFERS.

For primary bibliographic entry see Field 02L.
W70-02484

THE HYDROGEOLOGIC SETTING IN LOS ANGELES COUNTY, CALIFORNIA,

Los Angeles County Flood Control District, Calif., Water Conservation Div.
For primary bibliographic entry see Field 02L.
W70-02490

THE AMELIORATION OR PREVENTION OF SALT-WATER INTRUSION IN AQUIFERS - EXPERIENCE IN LOS ANGELES COUNTY, CALIFORNIA.

Los Angeles County Flood Control District, Calif. For primary bibliographic entry see Field 02L.
W70-02491

UNDERGROUND WATER DEVELOPMENT.

For primary bibliographic entry see Field 06E.
W70-02530

RATE AND DIRECTION OF GROUNDWATER CIRCULATION IN CLOSE SPACED BEDROCK AND GRAVEL WELLS UNDER NON-SYNCHRONOUS PUMPING TIME AND RATES, Connecticut Univ., Storrs. Inst. of Water Resources.

L. Frankel.

Research Project Technical Completion Report, 1969. 4 p. OWRR Project A-005 (CONN).

Descriptors: Glaciolacustrine, *Sedimentation, Sorting, *Grain size, Glacioluvial.

Identifiers: Hydrology, Groundwater, *Water supply, Contamination, *Water yield.

Two low yield well fields were developed in the complexly bedded glaciolacustrine and glacioluvial materials of the Skungamaug River Valley. Textural analyses, measurement of flow patterns in close spaced wells and observations of well reactions to various tests suggest that the individual beds and lenses of sediment vary so greatly in their hydrologic characteristics that they constitute not a single aquifer but a complex of intermingled aquifers of limited horizontal and vertical extent. As a result of this complex, varying and presently unpredictable degrees of interaction exists among these sedimentary units within the system. The complex cannot be evaluated as a single, uniform system. In addition, it appears from the test performed, that the total grain size distribution characteristics of each sedimentary unit have a greater relationship to the hydrology of the unit than average grain size values of these units.
W70-02735

RELATION OF BEDROCK FRACTURE SYSTEMS TO UNDERGROUND WATER SUPPLIES IN THE STAFFORD SPRINGS, SOUTH CONVENTRY, SPRING HILL, AND WESTFORD QUADRANGLES, Connecticut Univ., Storrs.

For primary bibliographic entry see Field 02F.
W70-02756

4C. Effects on Water of Man's Non-Water Activities

URBAN RUNOFF BY ROAD RESEARCH LABORATORY METHOD,

Illinois State Water Survey, Urbana. Michael L. Terstriep, and John B. Stall. ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6878, p 1809-1834, Nov 1969. 26 p, 19 fig, 6 tab, 19 ref, append.

Descriptors: *Storm runoff, *Urbanization, *Mathematical models, Rainfall-runoff relationships, Roads, Model studies, Storm drains, Hydraulics, Hydrology, Open channel flow, Sewers, Streamflow, Planning.
Identifiers: Urban hydrology, Urban planning.

A simple mathematical model of an urban basin presented in 1962 by the British Road Research Laboratory is tested on three urban watersheds in the United States. The basins are located in Baltimore, Md. and Chicago, and Champaign, Ill. They contain 0.395, 12.5, and 2290 acres respectively. The model produces a runoff hydrograph by applying rainfall to only the directly connected impervious area of the basin. The basin is described by a time-area diagram and a discharge-storage relationship. The peak discharges of actual and predicted hydrographs are compared for 39 storms and complete hydrographs are shown for 8 of these. To apply the model to a basin, the pattern of impervious areas must be known in detail, as well as the slopes and sizes of all surface and subsurface drains. (Knapp-USGS)
W70-02467

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4C—Effects on Water of Man's Non-Water Activities

SALT-WATER ENCROACHMENT INTO AQUIFERS.

For primary bibliographic entry see Field 02L.
W70-02484

COMBATING SALT-WATER ENCROACHMENT INTO THE BISCAYNE AQUIFER OF MIAMI, FLORIDA,

Dade County Engineering Dept., Miami, Fla.
For primary bibliographic entry see Field 02L.
W70-02485

SALT-WATER INTRUSION IN SOUTHEASTERN FLORIDA,

Central and Southern Florida Flood Control District, West Palm Beach, Fla.
For primary bibliographic entry see Field 02L.
W70-02486

PROTECTING LONG ISLAND AQUIFERS AGAINST SALT-WATER INTRUSION,

New York State Dept. of Conservation, Albany, Div. of Water Resources.
For primary bibliographic entry see Field 02L.
W70-02488

A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967,

Institute for Land and Water Management Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 06B.
W70-02495

BAER V BD OF COUNTY COMM'R'S OF WASHINGTON COUNTY.

257 A2d 201-205 (Ct App Md 1969).

Descriptors: *Maryland, *Alteration of flow, *Riddance (Legal aspects), *Relative rights, Pipes, Drains, Drainage, Surface waters, Subsurface waters, Water control, Drainage water, Legal aspects, Judicial decisions, Surface runoff, Drainage systems, Drainage effects, Running waters, Groundwater, Groundwater movement, Repulsion (Legal aspects), Land tenure, Absorption, Diversion, Inhibition, Rainwater. Identifiers: Injunction (Prohibitory).

Washington County, through the use of pipes, channeled water from higher adjacent lots to a point near the lot of a lower owner. As a result the lower owner was deprived of the natural processes of absorption and diversion. Substantial quantities of water accumulated on the lower owner's lot after heavy rains, and the lower owner sought injunctive relief. The lower court dismissed the owner's complaint. On appeal, the Court of Appeals of Maryland remanded the case, holding that while a servient estate is required to accept water from higher adjacent lots, the upper proprietor must act reasonably. (Marsee-Florida)
W70-02517

SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK,

Geological Survey, Miami, Fla. Water Resources Div.
Milton C. Kopolinski, and Aaron L. Higer.
Geological Survey Open-file Report, Sept 1969. 97 p, 21 fig, 8 tab, 25 ref.

Descriptors: *Water quality, *Water levels, *Streamflow, *Florida, *Wetlands, Swamps, Surface waters, Ecology, Droughts, Water pollution sources, Dissolved oxygen, Sampling, Drought resistance, Hydrology, Low Flow. Identifiers: *Everglades, *Shark River.

Hydrobiological investigations were made in Everglades National Park and are summarized under

four main topics: (1) vegetative changes, (2) population dynamics of animals, (3) repopulation of small aquatic animals after droughts, and (4) water-quality characteristics. Changes of vegetation in Shark River Slough from 1940 to 1964 showed a decrease in acreage of wet prairie communities and an increase in sawgrass marshes and woody vegetation. The apparent reasons for the changes are shortened wet periods, increase in fires, and loss of soil. Long wet periods result in an abundance of small aquatic animals and the successful formation of wading bird rookeries. (Knapp-USGS)
W70-02631

SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS,

Forest Service (USDA), Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station. W. R. Meehan, W. A. Farr, D. M. Bishop, and J. H. Patrie.
USDA Forest Serv Res Paper PNW-82, 1969. 45 p, 18 tab, 15 fig, 69 ref.

Descriptors: *Clearcutting, *Salmon, *Water quality, *Aquatic habitats, Alaska, Water temperature, Sedimentation, Streamflow, Lumbering. Identifiers: *Spawning streams, Channel debris, Log-debris jams.

The effects of clearcutting on streamflow, suspended sediment, stream temperature, log-debris jams, and indirectly on salmon populations of two watersheds were evaluated and compared with an uncut watershed in southeast Alaska. Although some effects were observed, the timber harvest did not appear harmful to salmon habitats or populations. (Helmers-Forest Service)
W70-02724

4D. Watershed Protection

SOIL CONSERVATION POLICY.

Pa Stat Ann tit 55, sec 850 (1963).

Descriptors: *Pennsylvania, *Soil conservation, *Soil erosion, *Erosion control, Flood control, Legislation, Legal aspects, Natural resources, Dams, Reservoirs, Navigation, Rivers, Harbors, Public health, Wildlife conservation. Identifiers: *Public policy, Public welfare.

It is the declared policy of the state to provide for the conservation of soil and soil resources and for the control and prevention of soil erosion in order to preserve natural resources, assist in flood control, prevent impairment of dams and reservoirs, assist in maintaining the navigability of rivers and harbors, preserve wildlife, preserve the tax base, protect public lands, and protect and promote the health, safety and general welfare of the people of the state. (Keith-Florida)
W70-02521

REFORESTATION SURVEY.

Pa Stat Ann tit 32, secs 673-677 (1967).

Descriptors: *Pennsylvania, Surveys, *Investigations, *Flood control, Administrative agencies, Natural resources, Data collections, On-site investigation, Land resources, Conservation, Land use, Water resources, Water resources development, Legal aspects, Legislation, Reforestation, Forest management, Land development, Land management.

The Department of Forests and Waters is authorized to make an investigation and reforestation survey, with flood control as the objective, of the three watersheds of the Commonwealth. The investigation and survey are to be made of all private lands and all abandoned farm lands and

submarginal lands. The Department shall make a complete report of its reforestation survey to the General Assembly, so that the General Assembly may be advised regarding adoption of a comprehensive flood control program. Whenever any grant or right in the bed of any navigable waters in the Commonwealth becomes inimical to the public interest, it shall be voided. The Department is empowered to determine when any such right, grant or privilege has become derogatory or inimical to the public interest. A full hearing with due notice is required before such finding may be made. Appeals may be made by aggrieved parties to the Superior Court. (Kelly-Florida)
W70-02532

UNITED STATES PROJECTS.

For primary bibliographic entry see Field 06E.
W70-02533

RANGE SEEDING PROBLEMS AND RESEARCH IN THE PINYON-JUNIPER WOODLAND TYPE OF SOUTHWESTERN UNITED STATES,

Agricultural Research Service, Washington, D.C. Crop Research Div. F. B. Gomm, and Fred Lavin. Annals of Arid Zone, Vol 7, No 2, p 209-220, 1968. 1 fig, 35 ref.

Descriptors: *Southwest U.S., *Pinyon pine trees, *Juniper trees, *Range management, *Semiarid climates, Brush control, Grazing, Droughts, Land use, Grasses, Rehabilitation, Planting management, Natural resources, Vegetation, Carrying capacity, Economics, Costs, Ecology, Decision making, Rainfall, Seeds, Forests, Forages, Range grasses, Revegetation. Identifiers: *Reseeding.

Pinyon-juniper woodland is used primarily for spring and fall grazing. Use of juniper wood for fuel and fence posts has declined to the point that juniper is now considered a weed species. These lands have been traditionally over grazed, and now have an average stocking rate of 7 acres per animal-unit-month (AUM). In areas where range improvement is economically justified, it is often necessary to kill trees before planting forage grasses. Pinyon-juniper woodlands cover about 60 million acres in the Southwest. The climate is semiarid and subject to frequent droughts. Potential economic returns from livestock must be weighed against costs of controlling pinyon and juniper and reseeding before a decision can be made regarding a particular area. A thorough study of the ecological conditions is recommended as a preliminary step necessary to decision making and choice of species to be reseeded. A list of potentially useful forage species is given. (Crouse-Arizona)
W70-02555

HYDROGRAPHIC AND SEDIMENTATION SURVEY OF KAJAKAI RESERVOIR, AFGHANISTAN,

Geological Survey of Afghanistan, Kabul. Water Resources Div.
For primary bibliographic entry see Field 02J.
W70-02669

SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS,

Forest Service (USDA), Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station. For primary bibliographic entry see Field 04C.
W70-02724

EROSION PREVENTION EXPERIMENTS,

Connecticut Univ., Storrs. Chesley J. Posey. Proc 13th Congr Int'l Assoc for Hydr Res, Vol 2, p 211-219, 1969. OWRR Project A-009-CONN.

Identification of Pollutants—Group 5A

Descriptors: *Erosion control, Stream stabilization, Groundwater replenishment.
Identifiers: *Riprap, *Reverse filters, Rock sausages, Gabions.

Test of erosion protection in model channels, in an apparatus designed to permit comparisons under severe erosion exposure, and in field installations show that successive layers, each meeting the specifications for reverse filters will give complete protection to the finest, most erodible soils. Accurate prediction of the sizes necessary for the top-most layer, to prevent it from being washed away, cannot be made, and this must be determined by trial. If large enough stones are not available, smaller stones may be bound with mesh tubing, giving greatly increased resistance to erosion. Observations of field installations are being continued under auspices of the Connecticut Department of Transportation. A 16 mm silent color motion picture film summarizes the results obtained so far in form suitable for showing to engineering designers and maintenance men.
W70-02730

STATE V ARCHER.

107 NJ Super 77, 257 A2d 1-2 (1969).

Descriptors: *New Jersey, *Eminent domain, *Erosion control, *Condemnation, Judicial decisions, Hurricanes, Beach erosion, Beaches, Streams, Erosion, Coastal engineering, Shore protection, Soil erosion, Tidal effects, Waves (Water), Public lands, Legislation, Legal aspects, Projects, Federal government, State governments, Water law.

A New Jersey statute authorized the Department of Conservation and Economic Development to condemn lands for improvement or development of waterways, streams, rivers, creeks, or waterfront or oceanfront property. The Department took lands in the Borough of Union Beach for purposes of hurricane and shore protection in conjunction with a federal project for beach erosion control and hurricane protection. The Superior Court of New Jersey, Appellate Division, held that the taking was authorized by the statute, and that such taking was for public purpose, though the program necessarily affected only particular areas. (Marsee-Florida)
W70-02834

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

RESPIRATION CORRECTIONS FOR BACTERIAL UPTAKE OF DISSOLVED ORGANIC COMPOUNDS IN NATURAL WATERS.

North Carolina State Univ., Raleigh. Dept. of Zoology.

John E. Hobbie, and Claude C. Crawford.

Limnology and Oceanography, Vol 14, No 4, p 528-532, July 1969. 5 p, 2 fig, 2 tab, 8 ref. OWRR Project A-015-NC, and NSF Grant GB-5678.

Descriptors: *Respiration, *Bacteria, *Radiochemical analysis, *Organic compounds, Microorganisms, Carbon dioxide, Ponds, Sampling, Analytical techniques, Plankton, Carbon radioisotopes, Tracers, Tracking techniques.
Identifiers: Carbon-14 analysis.

The uptake of C-14 labeled organic compounds has been used by many workers to study heterotrophic microorganisms in natural waters. However, if flux rates of organic compounds are to be measured, the loss of carbon dioxide during incubation becomes an important source of error. A method is proposed in which the experiment is run in a closed system and the carbon dioxide collected after killing and acidification. Phenethylamine on chro-

matographic paper is the absorbing agent and the paper is counted by liquid scintillation. Studies of 19 compounds from pond water showed that 60% (aspartic acid) to 8% (arginine) of the labeled material entering the microorganisms was resired. (Gabriel-USGS)
W70-02641

ALKALINITY BUDGET OF THE COLUMBIA RIVER.

Oregon State Univ., Corvallis. Dept. of Oceanography; Federal Water Pollution Control Administration, Washington, D.C. Div. of Engineering Development; and Idaho Univ., Moscow. Dept. of Chemistry.

For primary bibliographic entry see Field 02K.
W70-02642

LIMITATION OF ALGAL GROWTH IN SOME CENTRAL AFRICAN WATERS.

Malawi Univ., Limbe.
For primary bibliographic entry see Field 05C.
W70-02646

INTERACTION OF PESTICIDE POLLUTANTS AND AQUATIC FOOD-CHAIN ORGANISMS,

Clemson, Univ., S.C.
For primary bibliographic entry see Field 05C.
W70-02677

EFFECT OF BORON ON BIOLOGICAL WASTE TREATMENT,

Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-02734

STUDIES ON PHOSPHOROUS TRANSFORMATIONS IN EUTROPHIC LAKES,

Connecticut Univ., Storrs.
For primary bibliographic entry see Field 05C.
W70-02747

INTERACTION OF INORGANIC AND ORGANIC FERTILIZER MATERIALS WITH PESTICIDES AS RELATED TO WATER QUALITY IN SOILS,

Arkansas Univ., Fayetteville. Dept. of Agronomy.
For primary bibliographic entry see Field 05B.
W70-02761

ANALYSIS OF TRACE ELEMENTS IN WATER,

Rhode Island Univ., Kingston. Water Resources Center.
Vincent C. Rose.
Technical Completion Report 1969. 8 p. OWRR Project A-019-R1.

Descriptors: *Pollution, *Trace metals, *Ion exchange, *X-ray fluorescence.
Identifiers: *Nuclear fuel.

The purpose of this research was to develop ion exchange techniques for rapidly concentrating certain trace metals from water and to develop methods of analyzing the samples on ion exchange media. The study was limited to uranium, zirconium, tin, nickel, chromium and iron. Cation exchanger load filter papers were used to concentrate the solutions using a flow rate of 23 ml/sq cm/min. The fluid was recycled through the paper six times. The papers were analyzed by x-ray fluorescence analysis. As little as 25 micrograms of metal gave a statistically valid signal. A linear relation between normalized count rate and the amount of metal was found. The lower analytical detection limit was 0.125 milligram or all elements and the upper limit (98% recovery) ranged from 0.6 milligrams for chromium to 1.25 milligrams for uranium.
W70-02768

BIOASSAY OF WATER POLLUTANTS WITH CULTURED MAMMALIAN CELLS.

Rhode Island Univ., Kingston. Dept. of Biophysics.
Harold W. Fisher.
Technical Completion Report, Rhode Island Water Resources Center, 1969. 13 p, 1 tab, 11 fig. OWRR Project A-027-RI.

Descriptors: *Bioassay, *Pollutants, *Mammalian cells.

Plating efficiency tests of the growth of discrete macroscopic colonies from single cells of cultures of human and bovine cells were used to titrate the toxicity of various inorganic pollutants, herbicides and pesticides. Significant differences were found for the titration end-points of the test substances and a high degree of sensitivity to some of them was revealed. One of the most toxic pesticides, Rotenone (C₂₃H₂₂O₆) was analyzed by exposing single attached cells in the petri dish to selected concentrations of the pesticide for different lengths of time, then removing the pesticide and growing the surviving cells in fresh complete growth medium. A plot of the log of the surviving fraction as a function of exposure time gave a straight line at each concentration tested. The slopes of these lines as a function of the respective concentration of pesticide also gave a straight line passing through the origin. This suggests that perhaps there is no threshold for the toxicity of some water pollutants.
W70-02771

PROCEEDINGS OF THE EUTROPHICATION-BIOSTIMULATION ASSESSMENT WORKSHOP.

California Univ., Berkeley. Sanitary Engineering Research Lab, and Pacific Northwest Water Lab, Corvallis, Oreg.

Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Oregon, Pacific Northwest Water Lab p i-iv+281 p, 93 fig, 43 tab, 341 ref.

Descriptors: Eutrophication, *Conferences, Water pollution effects, Algal control, Water pollution, Toxicity, Lakes, Design criteria, Remote sensing, Minnesota, Sediment-water interfaces, California, Bioassay, Scenedesmus, Physiological ecology, Kinetics, Farm wastes, Benthos, Nitrates, Fluorescence, Nitrogen fixation, Environmental effects, Nutrient requirements, Communities (Biological), Carbon radioisotopes, Productivity, Rivers, Trace elements.

Identifiers: *Biostimulation, Algal growth, Water pollution assessment, Sanitary Engineering Research Laboratory (Calif), National Eutrophication Research Program, Continuous culture, Chemostats, Batch cultures, Acetylene reduction technique, Heterotrophy, Flagellates, Lake classification, Shagawa Lake (Minn.).

Eutrophication may be the most serious and pressing water quality problem we face, and new scrutiny of research approaches is required. The deliberations are presented of a group of workers in eutrophication held at Berkeley, California, during 19-21 June 1969. The sessions were sponsored by the Sanitary Engineering Research Laboratory, University of California, and the National Eutrophication Research Program, US Department of the Interior. Scope of the report is indicated by subjects of individual contributions: need for assays; chemostat assays; batch assays for determining algal growth potential; algal growth assessment by fluorescence techniques; kinetic assessment of algal growth; factors in utilization by Scenedesmus of nitrate from agricultural wastes; environmental and nutritional requirements for algae; assessment of nitrogen fixation by acetylene reduction; heterotrophy in algal flagellates; physiological ecology; physiological ecology of benthic algal communities; measurement of algal growth with radiocarbon; lacustrine classification; productivity of rivers; measurement of trace elements in the hydrosphere; design applications of biostimulation

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification of Pollutants

and toxicity criteria; remote sensing in water resources management; nutrient exchange between sediment and water; and Shagawa Lake (Minnesota) eutrophication research project. An index is provided. See also W70-02776 thru W70-02779. (Eichhorn-Wisconsin) W70-02775

NEED FOR ASSAYS,

California Univ., Berkeley, Sanitary Engineering Research Lab; and Pacific Northwest Water Lab, Corvallis, Ore.

Gerard A. Rohlich.

Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ., Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Oregon, Pac Northwest Water Lab, p 1-6, 1 fig, 6 ref.

Descriptors: *Bioassays, *Eutrophication, Nutrients, Water pollution sources, Limnology, Comparative productivity, Environmental effects, Water pollution effects, Planning, Water quality, Analytical techniques.

Identifiers: Provisional Algal Assay Procedure, Joint Industry/Government Task Force on Eutrophication, Norway, Algal cultures, Algal growth, Water pollution assessment, Comparative studies, Water quality criteria, Standardization, Reproducibility, Research planning.

Because millions of dollars in public funds will, in the next few years, be expended to implement programs for the control of nutrients received by natural waters, scientists and engineers should work toward establishment of bioassays which will give comparable and reproducible results. Some experience in use of such assays has been gained in Norway. A standazrdized bioassay should serve to: (1) assess available algal nutrients in absence of toxicants; (2) estimate the effect on algal growth of added stimulants; and (3) determine acceptable levels for reduction of algal nutrients in any given body of water. The Provisional Algal Assay Procedure proposed by the Joint Industry/Government Task Force on Eutrophication is intended to meet those needs. (See W70-02775). (Eichhorn-Wisconsin) W70-02776

ALGAL GROWTH ASSESSMENTS BY FLUORESCENCE TECHNIQUES,

Federal Water Pollution Control Administration, Alameda, Calif.

Richard C. Bain, Jr.

Proc of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ., Berkeley, Sanitary Engineering Research Lab and Nat Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 39-55, 9 fig, 20 ref, append.

Descriptors: *Algal growth, *Bioassays, *Fluorometry, California, Nutrients, Eutrophication, Chlorophyll, Fluorescence, Lakes, Rivers, Nitrogen, Biomass, Sewage, Farm wastes, Carbon cycle, Phosphorus, Phosphate, Nitrates, Industrial wastes, Water pollution effects, Denitrification, Spectrophotometry.

Identifiers: San Joaquin River (Calif), Merced River (Calif), Tuolumne River (Calif), Stanislaus River (Calif), Water pollution assessment, American River (Calif), Clear Lake (Calif), Eel River (Calif), Joint Industry/Government Task Force on Eutrophication, Provisional Algal Assay Procedure, Batch cultures, Chemostats, Chlorophyll a, Photobiology, Algal growth potential, San Francisco Bay.

Author describes procedures for assessing algal growth potential, in Joint Industry/Government Task Force's Provisional Algal Assay Procedure, by estimating algal chlorophyll fluorometrically or spectrophotometrically. Water smaples are filtered through glass fiber filters, preserved with magnesium carbonate, and filters kept frozen in dark

refrigerator. Chlorophyll concentration, extracted into solution by grinding the filter in acetone, is estimated by spectrophotometry (at wavelengths 630, 645 and 665 nanometers) or fluorometry. Correction for phaeophytin is accomplished by a second reading after treatment of sample with hydrochloric acid. Illustrative data for various California waters receiving sewage, agricultural, and industrial wastes are delineated in the report. In batch assays, peak fluorescence due to chlorophyll, characteristically appears within the first week, not necessarily paralleling peak biomass. Data analysis from such assays together with those for nutrient analysis permits interpretive applications of the procedure. Thus, for 44 data points from various streams in San Joaquin Valley, in which nitrogen is thought to be limiting, regression analysis of relationship between total N (milligrams/liter) and chlorophyll (micrograms/liter) yields ratio, total N/chlorophyll, with 95% confidence interval of 4.6-10.8, in good agreement with literature values for algal cells with nitrogen limiting. (See W70-02775). (Eichhorn-Wisconsin) W70-02777

BATCH ASSAYS FOR DETERMINATION OF ALGAL GROWTH POTENTIAL,

California Univ., Berkeley, Sanitary Engineering Research Lab.

William J. Oswald, and Suresh A. Gaonkar.

Proc of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ., Berkeley, Sanitary Engineering Research Lab and Nat Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 23-38, 8 fig, 13 ref.

Descriptors: *Cultures, *Algae, Eutrophication, Water pollution effects, Iron, Chlorella, Bioassays, Bioindicators, Activated sludge, Nutrients, Phosphorus, Nitrogen, Gravimetry, Spectrophotometry, Carbon radioisotopes, Centrifugation, Fluorometry, Volumetric analysis, Chlamydomonas, Toxicity, Euglena, Waste treatment.

Identifiers: *Batch assays, *Algal growth potential, Water pollution assessment, Pacific Northwest Laboratory, Provisional Algal Assay Procedure, Bottle tests, Phacus, Limiting factors, Synergism, Temperature effects, Selenastrum capricornutum, Photobiology, Anabaena flos-aquae, Microcystis aeruginosa, Scenedesmus obliquus, Pleomorphism, Cell size, Error analysis, Cell enumeration.

Successful use of algal cultures in studies of algal growth potentials, trace mineral analyses, tastes and odors, and toxicity, gives reason to believe they may be valuable for assessment of eutrophication potential in the 'bottle test' version of the Provisional Algal Assay Procedure (PAAP), as proposed by the National Eutrophication Research Program. While tests may lack elegance, they are simple, flexible, versatile, reliable, and applicable—criteria established as desirable for that program. Author feels that certain characteristics of the test, as presently recommended, require alteration. It is doubtful, for example, if requirements for vigorous shaking, rigid temperature control, and accessory gases are necessary. In addition, simplified incubation techniques and apparatus should be evaluated. Several of the techniques proposed for assessment of growth in cultures may be unnecessarily complex or expensive, whereas techniques of fluorescence analysis and volumetric analysis of growth—not now being considered—should be studied. Parameters of growth in PAAP could be evaluated in terms of growth levels for which they may be most useful; thus, a rational system might involve enumeration of cells for algal growth potentials (in milligrams/liter) of 0.4-10; fluorescence, for 10-100; and gravimetry, for 100-1000. (See W70-02775). (Eichhorn-Wisconsin) W70-02779

CONTINUOUS-FLOW (CHEMOSTAT) ASSAYS,

California Univ., Berkeley, Sanitary Engineering Research Lab.

Donald B. Porcella.

Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ., Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pacific Northwest Water Lab, p 7-22, 6 fig, 1 tab, 30 ref.

Descriptors: *Bioassays, Nutrients, Phosphorus, Kinetic theory, Environmental factors, Biomass, Growth rates, Algae, Oligotrophy, Limiting factors, Chlorella, Analytical techniques, Cyanophyta, Diatoms, Eutrophication, Water pollution effects, Systems analysis, Succession, Ecosystems, Cycling nutrients.

Identifiers: *Continuous culture, *Chemostats, Turbidostats, Nutrient limited growth, Luxury consumption, Provisional Algal Assay, Procedures, Selenastrum capricornutum, Selenastrum gracile, Growth limitation, Selenastrum, Algal growth, Anabaena, Biostimulation, Water pollution assessment.

Because their dynamic properties more nearly approximate ecological conditions than do batch cultures, continuous cultures operating in chemostat mode (constant flow-rate) have been utilized in a variety of studies of algal growth, including assessment of biostimulatory responses. Requirements for steady state continuous flow systems and characteristics of ideal chemostats with illustrations of idealized curves from an experiment concerning relative change in algal cell material and limiting phosphorus concentrations are included. In transient phases of chemostat operation, phosphorus concentrations are less than those calculated theoretically, probably due to 'luxury' consumption by algae. Considerations of mass balances and kinetics of algal growth, useful in derivation of continuous cultures theory, need be applied to natural ecosystems to elicit useful information on productivity, nutrient cycling, and successional relationships. Based on chemostat experiments described, utilizing both Selenastrum gracile and natural algal populations as 'seed', are areas requiring further study, including the following problems: multiple limiting factors; use of natural 'seed' populations; excessive washout and extinction of cultures in bioassay of oligotrophic waters; development of synthetic media; and profiles of biomass analysis and nutrient concentration during transient growth in order to establish appropriate kinetic parameters. (See W70-02775). (Eichhorn-Wisconsin) W70-02779

MEMBRANE FILTER-FLUORESCENT-ANTIBODY METHOD FOR DETECTION AND ENUMERATION OF BACTERIA IN WATER,

North Texas State Univ., Denton, Dept. of Biology.

Rufus K. Guthrie, and Dennis J. Reeder.

Applied Microbiology, Vol 17, No 3, p 399-401, Mar 1969, 1 fig, 1 tab, 8 ref.

Descriptors: *Bacteria, *Coliforms, *Fluorescence, *Technical feasibility, Water pollution sources, Water pollution.

Identifiers: *Technique, Membrane filter methods, Fecal pollution, Escherichia coli, Fluorescent-antibody techniques.

The best currently available standard method for enumerating coliform bacteria (indicators of fecal pollution, and thus potentially endangering waters) requires from 18-24 hours for completion. An application of the fluorescent antibody technique to coliform detection and counting requires only 5-12 hours for completion. In this new application, the sample of water being tested was pulled through a black, gridded membrane filter, and incubated on Trypticase Soy Agar. After incubation at 35°C the membrane was placed back on the filter apparatus, overlaid with normal rabbit serum, and allowed 5 minutes contact. This was then pulled through by negative pressure. Next, the colonies were overlaid with specific or pooled labeled antiserum, given 15-20 minutes contact, then pulled through. After washing with buffered saline and glycerol solution, colonies were counted with a ten-power

Sources of Pollution—Group 5B

dissecting microscope rigged for fluorescence observation. Coliform counts using the new technique compared favorably with standard MPN and m-FC techniques. (Gerhold-Wisconsin) W70-02782

INTERPRETATION OF RADIONUCLIDE UPTAKE FROM AQUATIC ENVIRONMENTS,
Oak Ridge National Lab., Tenn. Radiation Ecology Section.

Daniel J. Nelson.
Nuclear Safety, Vol 5, No 2, p 196-199, 1964. 12 ref.

Descriptors: *Radioisotopes, *Aquatic environment, Chlorella, Tracers, Photosynthesis, Carbon radioisotopes, Fish, Clams, Strontium radioisotopes, Tennessee River, Trophic level, Algae, Caddisflies, Food chains, Stable isotopes, Radioactive waste disposal, Oceans, Foods, Absorption, Hazards, Cesium, Hydrogen, Deuterium, Tritium.

Identifiers: *Uptake, Specific activity, Chlorella pyrenoidosa, Biological half-life, Clinch River (Tennessee), Physical half-life, Hydropsyche cockerelli, Body burdens, Pomoxis annularis, Gastrointestinal tract.

Specific activities in aquatic organisms help explain differences in radionuclide uptake. Data evolved by routine radiological monitoring establishes safety standards for radionuclide releases to freshwater habitats. Equilibrium levels of radionuclides between organisms and environment are expected only for elements with short biological half-life in tissue. Method of specific activities is based on assumption that if the distribution of a stable element is known between an organism and its environment, it may be used to predict radionuclide concentrations in water organisms receiving constant radionuclide releases. The relation of strontium and strontium-90 in fish may be used to calculate expected body burdens. Specific activity relation might be a criterion for limiting radioactive waste disposal in oceans. While specific activity of a chemical element in environment of human food organisms is below the permissible specific activity for the element in a human body, man cannot obtain more than his permissible body burden from the seas. Direct application of the specific activity concept applies only to those radionuclides which constitute an absorption hazard. With radionuclides for which absorption is not critical, specific activities may be related to irradiation of the gastrointestinal tract by its contents. (Jones-Wisconsin) W70-02786

SIMULTANEOUS DETERMINATION OF Zn-65-30 AND P-32-15 IN SHELLFISH BY RADIOCHEMICAL TECHNIQUES,

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Lab. of Physical and Engineering Sciences.

J. L. Setser, and T. C. Rozzell.
Talanta, Vol 12, p 903-911, 1965. 3 tab, 14 ref.

Descriptors: *Zinc radioisotopes, *Phosphorus radioisotopes, *Shellfish, *Radiocchemical analysis, Clams, Oysters, Crabs, Anion exchange, Resins, Radioactivity, Precision tests, Chromium, Iron, Cobalt radioisotopes, Potassium radioisotopes, Strontium radioisotopes, Cesium, Manganese, Arsenic radioisotopes, Sodium, Oregon, Water pollution effects, Water pollution sources, Radioecology.

Identifiers: *Water pollution identification, Matrix methods, Sensitivity, Mercury radioisotopes, Ruthenium radioisotopes, Zirconium radioisotopes, Niobium radioisotopes, Yttrium radioisotopes, Tillamook Bay (Oregon), Spectrum stripping methods, Half-life.

Zn-65 (radiozinc) and P-32 (radiophosphorus) are created by neutron activation in single-pass water-cooled reactors. The usual procedure in such reactors involves circulation of river water, after

removal of suspended materials by water treatment as coolant, around and through the reactor, and after several hours, returning the heated water to the river. A radiocchemical procedure for rapid determination of Zn-65 in shellfish is described. Because of interest in both Zn-65 and P-32, the procedure was combined with a classical phosphorus procedure and made compatible for simultaneous determination of the two nuclides. The method described is far less expensive than matrix or spectrum stripping procedures of determination, and has been applied to pure samples consisting only of Zn-65 and P-32, and to unknown samples consisting of a complex organic matrix. Tests for sensitivity, precision, and accuracy indicate the technique has direct application to determination of the two nuclides in shellfish analyzed over a period of eight months. Radiocchemical values agreed reasonable well with data from two separate matrix methods and with data for both nuclides reported by other investigators. (Jones-Wisconsin)

W70-02796

SEDIMENTARY PHOSPHORUS IN LAKE CORES--ANALYTICAL PROCEDURE,
Wisconsin Univ., Madison. Water Chemistry Lab.
Dennis A. Wentz, and G. Fred Lee.
Environmental Science and Technology, Vol 3, No 8, p 750-754, Aug 1969. 3 fig, 4 tab, 24 ref.

Descriptors: *Phosphorus, *Sediments, *Lakes, *Cores, *Chemical analysis, Nutrients, Eutrophication, Soil chemistry, Water chemistry, Sorption, Water pollution sources, Spectrophotometry, Hydrogen ion concentration, Phosphorus compounds, Iron.

Identifiers: *Water pollution identification, Water pollution assessment, Beer's law, Extraction procedures, Sample size, Orthophosphates, Phosphorus (Available), Fluorapatite, Error analysis, Precision, Calcium phosphate, Sample pretreatment, Adenosine monophosphate, Iron interference, Ferric phosphate, Sensitivity.

Available P (phosphorus) is an operationally defined fraction of soil influencing plant growth response. Procedures are described for extracting available P from sediments utilizing dilute mixture of hydrochloric and sulfuric acids. Size and pretreatment of sample, and pH of sediment-extractant mixture significantly affect amounts of P extracted. At pH employed, all sorbed orthophosphates should leach from sediments. Of fluorapatite and calcium phosphate added to samples, 88 and 11% respectively were recovered; adenosine monophosphate and ferric phosphate were not recoverable. Iron (22.3 milligrams iron/gram dry sediment) did not interfere. Relatively constant but significant errors result from turbidity and color leaching from sediment. Conversion to vanadomolybdate derivative yields yellow solution which is estimated spectrophotometrically at wavelength, 420 nanometers, which minimizes effects of iron, guarantees optimal sensitivity, and insures adherence to Beer's law. Five samples each at three concentrations (10.0, 2.00, and 1.00 milligrams P/liter), and three optical path lengths (1, 5, and 10 centimeters), yield following ranges of sensitivity (S—milligrams P/liter per 1% transmittance), precision (C—standard deviation of replicate measured concentrations), and working range (W—milligrams P/liter): S, 0.015-0.15; M, 0.02-0.2; C, 0.002-0.02; and W, 0.2-1.8. The technique has application in studies of accelerated eutrophication. (Eichhorn-Wisconsin) W70-02801

5B. Sources of Pollution**LEAD AND OTHER METAL IONS IN UNITED STATES PRECIPITATION,**

National Center for Atmospheric Research, Boulder, Colo. Atmospheric Science Lab.
Allan L. Lazarus, Elizabeth Lorange, and James P. Lodge, Jr.

Environ Sci and Technol, Vol 4, No 1, p 55-58, Jan 1970. 4 p, 7 fig, 1 tab, 14 ref.

Descriptors: *Water pollution sources, *Air pollution, *Metals, *Precipitation (Atmospheric), *Trace elements, Smog, Ions, Gasoline, Fuels, Pollutants, Industrial wastes, Water pollution.
Identifiers: Lead, Leaded gasoline.

The concentration of lead in the atmosphere is correlated with the amount of gasoline consumed in the U.S., and the concentration patterns for lead and four other metals — zinc, copper, iron, and manganese — are engendered primarily by human activity. Six months average values collected during 1966-67 from a network of 32 stations reveal that the northwest portion of the U.S. is conspicuously low in contamination; the northeast is relatively high, and the southwest and southeast vary from low to moderate, depending on the metal. (Knapp-USGS)
W70-02444

WATER QUALITY IN INDUSTRIAL AREAS: PROFILE OF A RIVER,
New York Univ., N.Y. Inst. of Environmental Medicine, and Environmental Protection Administration of New York City.
For primary bibliographic entry see Field 05C.
W70-02493**EXTRACELLULAR PRODUCTS OF PHYTOPLANKTON PHOTOSYNTHESIS,**
Westfield Coll., London (England). Dept of Botany; and University Coll., London. Dept. of Botany.

G. E. Fogg, Czeslawa Nalewajko, and W. D. Watt.
Proceedings Royal Society (B), Vol 162, p 517-534, 1965. 6 fig, 4 tab, 31 ref.

Descriptors: *Phytoplankton, *Photosynthesis, Bicarbonates, Radioactivity, Carbon radioisotopes, Lakes, Organic matter, Sea water, Primary productivity, Light intensity, Trophic level, Sampling temperature, Tracers, Chlorella, Hydrogen ion concentration, Alkalinity, Diatoms, Temperature, Weather, Epilimnion, Algae, Density, Seasonal, Marine plants, Water pollution sources.

Identifiers: *Extracellular products, Photic zone, Glycollic acid, Chemotrophy, Particulate matter, Blelham Tarn (England), Chlorella pyrenoidosa, Fixation, Tringford (England), Anabaena cylindrica, North Sea, Firth of Clyde (Scotland), Scotland, England, Lake Windermere (England), Carbon-14.

Following exposure in situ (3-24 hours) of lake or sea water samples, with added radioactive bicarbonate, radiocarbon was found in phytoplankters and in dissolved organic matter. Amounts in the water varied between 7 and 50% of total carbon fixed in photic zone of the water column. This production of labelled extracellular organic matter occurred under various conditions and with diverse phytoplankters. Estimation of primary productivity from fixation of carbon-14 in particulates only are probably erroneously low. Labelled organic substances in water are apparently liberated by intact photosynthesizing cells rather than from cells broken during filtration. Glycollic acid is possibly a principal substance. Over a wide range of light intensities, liberation of extracellular products by a given phytoplankton population was proportional to the carbon fixed in cells, tending to be relatively greater at low light intensities and at light intensities high enough to inhibit photosynthesis, when as much as 95% of total organic radiocarbon might be extracellular. Population density, period of exposure to labelled bicarbonate, and species differences influence such excretion. Extensive extracellular liberation, by phytoplankton, of photosynthetic products has important implications for studies of aquatic trophic relationships. (Jones-Wisconsin)
W70-02504

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources of Pollution

REPORT ON THE NUTRIENT SOURCES OF LAKE MENDOTA. Wisconsin Univ., Madison.

Wisconsin Dep of Resource Development, Madison Water Resources Div, Report to the Lake Mendota Problems Committee, Jan 1966. 41 p, 4 fig, 12 tab, 58 ref.

Descriptors: *Lakes, *Fertilization, *Eutrophication, Sewage, Water chemistry, Precipitation (Atmospheric), Cities, Rural areas, Wetlands, Drainage water, Base flow, Nutrients, Nitrogen, Phosphorus, Seepage, Zoning, Diversion, Wisconsin, Water pollution sources.

Identifiers: *Lake Mendota (Wis), *Nutrient sources, Madison (Wis).

Existing information on the amounts and sources of plant nutrients entering Lake Mendota, Wisconsin, was reviewed and estimates of the current amount of plant nutrients entering the lake were made. Previous studies on the lake's ten tributaries indicated that about 7,100 pounds of soluble phosphorus entered the lake in 1946-1947, equivalent to 0.76 pounds/acre or 0.0075 milligrams/liter phosphorus, with about 200,000 pounds of nitrogen, mostly as nitrates. Streams from predominantly agricultural drainage generally showed low phosphorus and high nitrate nitrogen concentrations. Some tributaries were found to have abnormal concentrations due to contributions from manured land, sewage, and canning waste treatment plants. Estimates of current nutrient sources--to be treated with caution--indicated the following annual contribution from various sources: Municipal and industrial wastewater-nitrogen 47,000 lbs (8%), phosphorus 17,000 lbs (36%); urban runoff-nitrogen 30,300 lbs (5%), phosphorus 8,100 lbs (17%); precipitation on lake surface-nitrogen 97,000 lbs (17%), phosphorus 140 to 7,600 lbs (2%); rural runoff-nitrogen 52,000 lbs (9%), phosphorus 20,000 lbs (42%); ground water-nitrogen 250,000 lbs (45%), phosphorus 600 lbs (2%); nitrogen fixation-80,000 lbs (14%). A total of 556,300 lbs of nitrogen and 47,000 lbs phosphorus were estimated to be entering the lake, although no reliable estimates could be placed on marsh drainage. (Kuney-Wisconsin)

W70-02506

INDUSTRIAL WASTES.

For primary bibliographic entry see Field 06E.

W70-02548

THERMAL DISCHARGES FROM LARGE NUCLEAR PLANT, Philadelphia Electric Co., Pa. Dept. of Engineering and Research; and Cornell Univ., Ithaca, N.Y. Dept. of Zoology.

Stanley Moyer, and Edward C. Raney.

ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 95, No SA6, Paper 6983, p 1131-1163, Dec 1969. 33 p, 13 fig, 11 tab, 20 ref.

Descriptors: *Nuclear powerplants, *Cooling water, *Thermal pollution, *Mixing, *Water pollution control, Canals, Discharge (Water), Jets, Turbulence, Dispersion.

Identifiers: *Thermal effluent mixing.

The cooling water requirements of the atomic powerplant on the Susquehanna River are 3350 cfs. Periods of low river flow, high natural river water temperatures, and high wet bulb temperatures are considered the most critical times for aquatic organisms. Hydraulic model tests resulted in the development of an efficient jet injection system which gives maximum mixing. A jet 5 fps to 8 fps at the end of a long canal introduces the effluent throughout the entire depth of the water column in the reservoir. This was superior to the use of a short discharge canal with a weir to release the warm water at the surface. At the critical seasons an increase of ambient water temperature of 13 deg F introduced as a jet was satisfactory in meeting the

temperature requirements of the fishes and associated organisms. An open circulating system is to be used with cooling towers to reduce the effluent from 21 deg F to 13 deg F above ambient. Low approach velocities at the cooling water screen structures are recommended to safeguard fishes. (Knappe-USGS)

W70-02635

BRINE SPRINGS IN THE ZWICKAU-OELSNITZ COAL AREA (GERMAN), Dieter Schraber.

English and Russian summaries. Zeitschrift fur Angewandte Geologie, Vol 14, No 8, p 431-439, Aug 1968. 9 p, 9 fig, 2 tab, 19 ref.

Descriptors: *Groundwater, *Brines, *Springs, *Coal mines, Water chemistry, Salinity, Discharge (Water), Sodium, Potassium, Calcium, Iron, Magnesium, Sulfates, Carbonates, Trace elements, Strontium radioisotopes.

Identifiers: *Germany, Zwickau-Oelsnitz.

A detailed description is presented of the brines emerging from the pits of the Zwickau-Oelsnitz area on the basis of hydrogeological and geochemical studies. Migration of the brines from the source area in the Thuringian basin is the most probable explanation because of the extensive NW-SE fault zones which create the paths followed by the brines. (Gabriel-USGS)

W70-02673

STOCHASTIC BASIS FOR COMPREHENSIVE RIVER BASIN PLANNING: PHASE I, Union Coll., Schenectady, N.Y. Water Resources Research Group.

For primary bibliographic entry see Field 06A.
W70-02681

CONSIDERATIONS ON HYDRAULIC MODELS TO BE EMPLOYED TO STUDY RECIRCULATION INTAKE CONDITIONS OF COOLING WATER IN STEAM POWER STATIONS, Universidad de la Republica, Montevideo (Uruguay). Dept. of Fluid Mechanics.

O. J. Maggiolo, and J. Spitalnik.

Journal of Hydraulic Research, Vol 5, No 3, p 189-207, 1967. 3 tab, 5 fig, 10 ref.

Descriptors: *Temperature, *Hydraulic similitude, *Hydraulic models, *Cooling, Path of pollutants, Heat budget, Energy budget, Thermal power plants, Recirculated water, Solar radiation, Heat transfer, Streams, Rivers, Estuaries.

This paper describes the use of models for studying the time necessary for hot water to circulate from the outlet of the condenser to the intake of the cooling water circuit of a thermal power station and temperature time changes of cooling water in the neighborhood of the pump-intake. This can be used in studying of peak load thermal power stations. In this paper the conditions to be fulfilled in the construction of a hydraulic model and the effect of the solar energy radiation are analyzed. The heat transferred to the water from the outside space is neither a function of the water temperature nor a function of the atmosphere temperature. This temperature changes from hour to hour, producing an accumulative effect of heat in the water, characteristic of a non-steady process. The temperature and relative humidity of the air change along the day and the power produced by the station is also variable. These conditions are considered in order to select the most convenient values for the scales of the model. The method is applied to the determination of a model with a horizontal scale of 1:250 and a vertical scale of 1:40 for two steam power stations existing in the Bay of Montevideo on the Rio de la Plata. (Novotny-Vanderbilt)

W70-02707

USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES, Worcester Polytechnic Inst., Mass. Alden Hydraulic Lab.

L. J. Hooper, and C. N. Lawrence.

Boston Society of Civil Engineers, Presented at Meeting held Feb 5, 1958, Hydraulics Section, p 356-365, 1958. 2 fig.

Descriptors: *Hydraulic models, *Cooling, Hydraulic similitude, Heat budget, Temperature, Reynolds number, Froude number, Streams, Heat balance, *Heat transfer, Convection, *Thermal pollution.

The use of hydraulic models for thermal pollution studies is discussed. Such models should satisfy Reynolds' and Froude modified densimetric criteria. Other criteria must be taken into account such as temperature and heat characteristics that sometimes require model construction on a 1/1 (prototype to model) basis. Experimental results show that the most important method of heat disposal has been the heat carried downstream by the river itself. The heat that can be transferred to the air has normally been found to be only a modest amount. Another possibility that should always be examined in a model study and the subsequent analysis of prototype performance is the possibility of heat storage in the pool. (Novotny-Vanderbilt)

COOLING WATER STUDIES AT ELECTRIC POWER STATION,

Duke Power Co., Charlotte, N.C.

Fred R. Gray, and Ben J. Stephenson.

Journal of the Power Division, Proceed of ASCE, Vol 95, No P02, Proc Paper 6853, p 293-303, Oct 1969. 1 tab, 12 fig.

Descriptors: *Hypolimnion, *Thermal power plants, *On site tests, *Thermal pollution, Lakes, North Carolina.

This study correlates field surveys and theoretical analyses of thermal discharges (heat dissipation patterns of power plant cooling water discharges). Duke Power's Marshall steam station was selected as one of the eleven sites for this study. The Marshall steam station is located on Lake Norman, which has a surface area of 32,500 acres and a volume of over 1,000,000 acre-ft. Weather conditions are relatively mild for this area. In order to accomplish the necessary testing, a series of synoptic and continuous temperature monitoring stations were established to measure the diffusion of Marshall steam stations condenser cooling water. A complete weather station records wind speed and direction; solar radiation; relative humidity; rainfall; and maximum and minimum weekly temperatures. Water is drawn from the hypolimnion of an adjoining lake by use of an inverted skimmer. Heat dissipation patterns are displayed for various times of the year and under different meteorological and plant loading conditions by graphic illustrations. Conclusions were: (a) during the colder months of the year, the heated water spreads over the lake surface, where it is quickly cooled by the air and wind, (b) in the hot summer months, use of the cold bottom water for cooling results in discharge temperatures close to those of the lake surface water, (c) extensive temperature surveys have shown that only a small part of Lake Norman's cooling capacity is required to dissipate the waste heat from the Marshall Steam Station. (Guerrero-Vanderbilt)

W70-02713

A HYDRAULIC MODEL STUDY OF HEAT DISSIPATION AT KINCARDINE POWER STATION, Williamson (James) and Partners, Glasgow (Scotland).

David Ian Hunter Barr.

Proc Inst Civil Engineers, Vol 10, p 305-320, July 1958. 9 fig, 27 ref.

Effects of Pollution—Group 5C

Descriptors: *Thermal pollution, *Model studies, *Hydraulic models, *Thermal power plants, *Density currents, Stratification.
Identifiers: *Heat dissipation.

A model investigation was conducted to study the heat-dissipating capacity of the River Forth at Kincardine, where a 760-MW steam station would draw 1,025 cusecs of condenser circulating water from the river. After mention of the calculations to ascertain the tidal flow at Kincardine, the operation of the model is described, including reference to observations made on the river to assist calibration of the model and to a concurrently operated model used to investigate outfall scour. The results obtained from the model are outlined and comparison made between recordings for varying conditions. An estimate of heat losses for model and prototype is given, and it is shown that non-correspondence in this respect did not have a material effect on the results in the case of the Kincardine investigation. In the second part of the paper, the background to density-current simulation in models is discussed and flume experiments carried out in this connection are described. Some conclusions were: (a) as a result of the investigation, a considerable reduction in culvert length was made for the Kincardine project; (b) the model showed stratification in depths of less than 1 inch (4 ft prototype) and the degree of stratification was found sensitive to variation in basic density and to the outfall increments; (c) the technique for density current model studies is less fully developed than for models involving normal currents only, and there is scope for research on the subject. (Guerrero-Vanderbilt)
 W70-02717

AN EVALUATION OF THE USE OF SELECTIVE DISCHARGES FROM LAKE ROOSEVELT TO COOL THE COLUMBIA RIVER,
 Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
 R. T. Jaske.
 AEC Research and Development Report, BNWL-208, Feb 1966. 87 p, 24 fig, 7 tab, 17 ref.

Descriptors: *Cooling, *Heat transfer, Mathematical models, Computer models, Reservoirs, Streams, Density currents, Heat balance, Energy budget, Temperature, Thermal pollution, Thermal powerplants.

A review is conducted of the results and general operation of the annual Columbia River cooling program for 1963, 64, and 65. An effort was initiated to develop a digital computer model to solve cooling problems in rivers. In research operations with this model, an appropriate degree of agreement has been obtained between model calculations and measured data. It was found that the existence of density currents and subsurface jet formation cannot be ignored in the development of heat budgets because large errors are introduced by the transition from mixed flow to almost adiabatic flow conditions. A high degree of integration among the flood control, power, and cooling water users interests is required to minimize effects on fisheries. (Novotny-Vanderbilt)
 W70-02739

STUDIES ON PHOSPHOROUS TRANSFORMATIONS IN EUTROPHIC LAKES,
 Connecticut Univ., Storrs.
 For primary bibliographic entry see Field 05C.
 W70-02747

INTERACTION OF INORGANIC AND ORGANIC FERTILIZER MATERIALS WITH PESTICIDES AS RELATED TO WATER QUALITY IN SOILS,
 Arkansas Univ, Fayetteville. Dept. of Agronomy.
 Donald A. Brown.
 Available from the Clearinghouse as PB-188 913, \$3.00 in paper copy, \$0.65 in microfiche. Project completion report, Arkansas Water Resources Research Center, Sept 1969. 9 p, 2 tab, 2 ref. OWRR Project A-004-ARK.

Descriptors: *Diffusion (Self), Adsorption, *Pesticides, Nitrogen, Soils, Herbicides, *Separation techniques.
Identifiers: Time of interaction, Nitrogen sources.

Interaction of Fertilizers with Pesticides - The chemical, physical, and mineralogical analysis of Dundee silt loam, Crowley silt loam, and Sharkey clay were completed. A study of the effect of 6 nitrogen rates for 5 sources of nitrogen upon the adsorption of prometryne, aldrin and fluometuron over four time periods was completed. The effect of $(\text{NH}_4)_2\text{SO}_4$, NH_4NO_3 and Nitran upon the diffusion of fluometuron in agar, glass beads and Crowley silt loam was also measured. Adsorption of pesticides increased as the time of fertilizer-pesticide interaction was extended. The greatest adsorption of aldrin and prometryne was by Sharkey, followed by Crowley and Dundee. Increasing rates of nitrogen increased or decreased adsorption depending upon changes in pH and salt content. The diffusion of fluometuron in Crowley silt loam was affected by nitrogen sources, rate, and time of interaction. The movement was ten times slower than in glass beads or agar, indicating that a soil-fertilizer-fluometuron interaction was present. The adsorption and diffusion of these pesticides was found to be a very critical function of pH, salt content, and time of interaction.
 W70-02761

FERTILIZATION OF LAKES BY AGRICULTURAL AND URBAN DRAINAGE,
 Massachusetts Inst. of Tech., Cambridge. Dept. of Sanitary Chemistry.

Clair N. Sawyer.
 New England Water Works Association, Vol 61, No 2, p 109-127, June 1947. 5 fig, 6 tab, 6 ref.

Descriptors: *Sewage disposal, *Agricultural watersheds, *Runoff, *Fertilization, Lakes, Sewage treatment, Sewage bacteria, Nitrogen, Phosphorus, Algae, Copper sulfate, Effluents, *Microcystis aeruginosa*.

Identifiers: *Urban drainage, *Agricultural drainage, Biological response, Fertilization survey, Madison Lakes (Wis), Lake Mendota (Wis), Lake Waubesa (Wis), Lake Kegonsa (Wis).

The reported investigations disclose that agricultural drainage contributes annually about 4,500 pounds of nitrogen and 255 pounds of phosphorus per square mile of the watershed. Biologically treated sewage supplies annually approximately 6.0 of nitrogen and 1.2 pounds of phosphorus per capita, thus equating the enrichment of lake water from 1 square mile of agricultural drainage to 750 persons for nitrogen and to 212 persons for phosphorus. In 1946, lakes Monona, Waubesa, and Kegonsa, located on the outskirts of the city of Madison, received approximately 1,300 tons of nitrogen and 215 tons of phosphorus in organic and inorganic forms. The lakes retained from 30 to 60% of nitrogen received. The phosphorus concentration in lakes Waubesa and Kegonsa attained the high level above 0.25 parts per million (ppm) as compared with 0.01-0.02 ppm concentration found in less polluted lakes of southern Wisconsin. Importance of the hypolimnion, the nitrogen:phosphorus ratio, and a 'round-the-calender' records is stressed. *Microcystis aeruginosa* was a particularly obnoxious by-product of eutrophication, either because of its inherent reproductive potential or resistance to copper sulfate. Other data of this report have considerable immediate as well as historical interest. (Wilde-Wisconsin)
 W70-02787

CONTRIBUTIONS TO THE KNOWLEDGE OF NITROGENOUS COMPOUNDS AND PHOSPHATE IN THE LAKE WATERS OF JAPAN,

Tokyo Imperial Univ. (Japan). Geographical Inst.
 For primary bibliographic entry see Field 05C.
 W70-02788

EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES,

Ontario Water Resources Commission, Toronto. Div. of Research.
 For primary bibliographic entry see Field 05C.
 W70-02792

HYDROBIOLOGICAL CONTROL OF THE TREATMENT OF WASTE WATERS IN ACCUMULATION PONDS (CZECH),
 Technical Univ. of Prague (Czechoslovakia).

V. Sladecek.
 Voda, Vol 37, No 4, p 125-126, 1958. 1 fig, 7 ref.

Descriptors: *Water treatment, *Fish farming, *Ponds, *Pollution abatement, Fermentation, Pollutants.

Identifiers: *Polluted discharge, *Burned lime, Hyperpurification, Polypurification, Alpha-mesopurification, Beta-mesopurification, Polluted discharge, Accumulation ponds, Sugar beets.

A method is described for purification of liquid discharged from sugar beet factories introduced by Pytlík (1952). The technique consists of anaerobic fermentation of liquid stimulated by two additions to accumulation ponds of finely ground burned lime at a rate of 7500 kilograms/hectare; the first application is made in the fall and the second in winter. In the spring the pond is planted with fish. Aside from purification of the polluted liquid, the method provides from 300 to 500 kilograms/hectare of fish per year. The process of purification, according to the author, exhibits the following four phases: (1) Hyperpurification, during 4-1/2 winter months (fifth class of pollution, anaerobiosis); (2) Polypurification, during 1-1/2 spring months (fifth class of pollution, transition to aerobic conditions); (3) Alpha-mesopurification, during one spring month (fourth class of pollution, aerobic conditions); (4) Beta-mesopurification, during 4-1/2 summer months (third class of pollution, aerobic conditions). The study of hydrobiological control failed to provide reliable results due to dilution of discharged liquid by surface runoff. (Wilde-Wisconsin)
 W70-02793

5C. Effects of Pollution

WATER QUALITY IN INDUSTRIAL AREAS: PROFILE OF A RIVER,
 New York Univ., N.Y. Inst. of Environmental Medicine; and Environmental Protection Administration of New York City.

Gwyneth P. Howells, Theodore J. Kniepe, and Merrill Eisenbud.
 Environ Sci and Technol, Vol 4, No 1, p 26-35, Jan 1970. 10 p, 5 fig, 2 photo, 1 tab, 6 ref.

Descriptors: Eutrophication, *Estuaries, *Hudson River, Streamflow, Tidal effects, Nutrients, Water pollution, Thermal pollution, Water utilization, Currents (Water), Saline water intrusion, Estuarine environment.
Identifiers: Hudson River Estuary.

The ecology and water quality of the lower Hudson River were studied to learn the effects of variable fresh water flow, tides, and industrial development on the distribution of inorganic pollutants, nutrients, pesticides, and heat in the estuary. Changes that might be expected from increased use are: An increasing nutrient load from domestic sewage and some industrial processes, an increasing heat load, and an increased demand for industrial and domestic water. Potential eutrophic nuisance species of algae are present in the river, and the shores are populated by animals indicative of sewage pollution. Yet, serious fouling and deoxygenation have so far been avoided for most of the river. Heat additions to the aquatic environment are a major concern. In the Hudson, the volume of tidal flow can be utilized to disperse such heat; at the same time, it is clear that the capacity of the

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

river as a heat sink is severely limited during the peak summer demand by a low net flow and high ambient air temperatures. The effects of water extraction for any purpose on the present hydrological pattern in the river remain largely unknown. It seems probable that the extent and duration of salt water intrusion up the river will increase. (Knapp-USGS)

W70-02493

THE MECHANISM OF PHOTOSYNTHESIS,
Harvard Univ., Cambridge, Mass. Biological Labs.
For primary bibliographic entry see Field 02K.

W70-02503

EFFECT OF YELLOW ORGANIC ACIDS ON IRON AND OTHER METALS IN WATER,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 02K.

W70-02505

ENUMERATION OF AUTOTROPHIC AMMONIUM-OXIDIZING BACTERIA IN MARINE WATERS BY A DIRECT METHOD,
Rutgers - The State Univ., New Brunswick, N.J.
Dept. of Environmental Sciences.
For primary bibliographic entry see Field 07B.

W70-02507

FRESHWATER PRIMARY PRODUCTION BY A BLUE-GREEN ALGA OF BACTERIAL SIZE,
Nature Conservancy, Edinburgh (Scotland); Freshwater Biological Association, Ambleside, (England).
For primary bibliographic entry see Field 02H.

W70-02508

MODERN HYDROCARBONS IN TWO WISCONSIN LAKES,
Princeton Univ., N.J. Dept. of Geology; and Shell Oil Co., Houston, Tex. Technical Services Div.
For primary bibliographic entry see Field 02H.

W70-02509

INTERRELATIONS OF DISSOLVED ORGANIC MATTER AND PHYTOPLANKTON,
Michigan Univ., Ann Arbor. Dept of Zoology.
George W. Saunders.
The Botanical Review, Vol 23, No 6, p 389-409,
1957. 4 tab, 131 ref.

Descriptors: *Organic matter, *Phytoplankton, Limnology, Zooplankton, Algae, Colloids, Trace elements, Dissolved solids, Nutrients, Vitamins, Toxins, Inhibitors, Succession, Chlorella, Chelation, Ochromonas, Bacteria, Fungi, Aquatic plants, Assay, Distribution, Density, Chromatography, Radioactivity, Tracers, Water pollution effects, Physiological ecology, Algicides.

Identifiers: *Dissolved organic matter, Organic debris, Organic growth factors, Vitamin B1, Vitamin B6, Vitamin B12, Biotin, Histidine, Uracil, Reduced sulfur compounds, Antibiotic effects, Stimulants, Gonyaulax catenella, Gonyaulax tamarenensis, Gymnodinium breve, Mycosystis, Algaistic substances, Algalodynamic substances, Phormidiae, Pandorinae, Scenedesmeine, Microerustaceans, Cytoxic agents, Auxotrophy, Autotrophy, Heterotrophy, Nutrition, Physiology.

Limnologists attempt to explain distribution and interrelationships of freshwater organisms from the more conventional physical and chemical points of view. The biochemist and physiologist are beginning to understand basic metabolic pathways of synthesis and degradation. Micro-quantities of both organic and inorganic matter are significant to growth, behavior, and success of living organisms. With the new information from biochemistry and new tools and techniques, such as paper chromatography, chelate complexes, radioactive tracers, and microbiological assay, limnologists

may complete the unified picture. The attack may be initiated by use of pure cultures in the laboratory to determine the basic requirements of the more significant algal forms in terms of their ability to utilize various organic substrates, requirement for growth factors, reaction toward antibiotics, and their requirement for trace metals. Limnologists in the field may determine yearly cycles of specific organic nutrients, vitamins, and trace metals. Many questions may be answered by correlating laboratory and field studies with analyses of populations and their succession in nature. These tools should be considered and used to usher in a new era in limnology and the investigation of interrelations of dissolved organic matter, phytoplankton, and zooplankton. (Jones-Wisconsin)

W70-02510

A LIMNOLOGICAL COMPARISON OF TWELVE LARGE LAKES IN NORTHERN SASKATCHEWAN,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
For primary bibliographic entry see Field 02H.

W70-02511

THERMAL DISCHARGES FROM LARGE NUCLEAR PLANT,
Philadelphia Electric Co., Pa. Dept. of Engineering and Research; and Cornell Univ., Ithaca, N.Y. Dept. of Zoology.
For primary bibliographic entry see Field 05B.

W70-02635

NUTRIENT LIMITATION OF SUMMER PHYTOPLANKTON GROWTH IN CAYUGA LAKE,
Cornell Univ., Ithaca, N.Y.
D. H. Hamilton, Jr.
Limnology and Oceanography, Vol 14, No 4, p 579-590, July 1969. 12 p, 3 fig, 9 tab, 32 ref.

Descriptors: *Phytoplankton, *Eutrophication, *Lakes, *Nutrients, Carbon radioisotopes, Silicates, Water chemistry, Phosphates, Photosynthesis, Phosphorus, Sampling, Chlorophyll, Potassium compounds, Magnesium compounds.
Identifiers: Lake Cayuga (NY).

The effect on natural phytoplankton populations of various components of a defined culture medium has been assayed by measurement of C-14 assimilation under controlled conditions. Phytoplankton populations in Cayuga Lake, N.Y. are at least partially limited by nutrient availability during the period of stable conditions succeeding the vernal bloom. Sodium silicate consistently stimulated photosynthesis in June, July, and August; this is associated with the presence of silicon-requiring plankters, including some nondiatomaceous forms, and correlated with nutrient levels in situ. Both phosphate and silicate were present in low concentration. Despite low natural concentration, augmented phosphate did not stimulate photosynthesis, and some evidence suggests inhibition by phosphorus. Inhibition and enhancement by other components of the medium are discussed, as well as modifications of the C-14 enrichment experiment technique. (Gabriel-USGS)

W70-02643

LIMITATION OF ALGAL GROWTH IN SOME CENTRAL AFRICAN WATERS,
Malawi Univ., Limbe.
Brian Moss.

Limnology and Oceanography, Vol 14, No 4, p 591-601, July 1969. 11 p, 3 fig, 4 tab, 20 ref.

Descriptors: *Algae, *Productivity, *Eutrophication, *Water chemistry, Pollutants, Algal control, Nitrates, Phosphates, Sulfates, Seasonal, Lakes, Sampling, Ponds, Rivers, Reservoirs, Air temperature, Rain, Geology, Mapping, Nutrients.
Identifiers: *Africa, Malawi.

Levels of inorganic nutrients (nitrate, phosphate, sulfate) available for algal growth in nine bodies of water in Malawi were investigated, using enrichment bioassays with naturally present algae as test organisms. Nitrate or nitrate plus phosphate were potentially limiting to algal growth. There was no evidence of sulfate limitation. The relevance of enrichment bioassays to whole water body situations is considered. A model, illustrating invalid use of assays in the interpretation of seasonal succession in algal communities, is discussed. (Gabriel-USGS)

W70-02646

INTERACTION OF PESTICIDE POLLUTANTS AND AQUATIC FOOD-CHAIN ORGANISMS,

Clemson, Univ., S.C.

John K. Reed.

Available from the Clearinghouse as PB-188 794, \$3.00 in paper copy, \$0.65 in microfiche. Water Resources Research Institute, Technical Completion Report, Nov 1969. 18 p, 2 tab, 9 ref, append. OWRR Project A-013-SC.

Descriptors: *DDT, *Pesticide residues, Fish physiology, Absorption, Pesticide kinetics, Minnows, Gas chromatography, Radiochemical analysis.

Identifiers: *Biological magnification.

Small golden shiner minnows, *Notemigonus crysoleucas*, were exposed to a constant level of DDT either in water or in food. The DDT was ring labelled with carbon-14 and was assayed in a liquid scintillation system and by gas-liquid chromatography. Over a 15-day period the mean aqueous DDT concentration was 265 parts per trillion which resulted in a level of 180 ppb absorbed to the outside of the fish and 22,530 ppb absorbed internally. This represented nearly a 100,000 fold accumulation of DDT in fish from flowing water. When fish were fed contaminated food, no DDT was found absorbed externally on the fish or in the water. In both cases the level in the fish increased with time.

W70-02677

THE ECOLOGY OF THE YOUNG FISHES OF THE WEWEANTIC RIVER ESTUARY,

Massachusetts Univ., Amherst. Water Resources Research Center.

Charles F. Cole.

Available from the Clearinghouse as PB-188 795, \$3.00 in paper copy, \$0.65 in microfiche. Massachusetts Water Resources Research Center, Completion Report 69-1, Nov 1969. 15 p. OWRR Projects A-002-MASS.

Descriptors: *Estuarine fisheries, *Pesticide residues, *Fish populations, Massachusetts, Water pollution effects.

Identifiers: *Weewantic River, Buzzards Bay, Fisheries (Seasonal distribution), Fisheries (Distribution patterns).

The Weewantic River estuary in upper Buzzards Bay, Massachusetts was selected in 1964 for a long-term study of estuarine fishes and the factors that control their levels of abundance. Seven master's and two doctoral studies have been conducted during this period on the seasonality of fish eggs, larvae, juveniles and adults and on the life histories of the tomcod, rainbow smelt, cunner, tautog, and winter flounder. Additional studies on the seasonal distribution of certain physical and chemical parameters and studies on the historical use of the watershed since colonial times were carried out. Pesticide residue levels and their possible effects in winter flounder have also been investigated. Methods for quantifying ichthyoplankton sampling for in-situ mortality studies of winter flounder and rainbow smelt have also been evaluated. Between-year variation in the natural environmental parameters is a strong factor regulating size of year class in at least the tomcod, rainbow smelt and winter flounder. The study of man-caused environmental modifications on populations of estuarine

Effects of Pollution—Group 5C

fishes must take into consideration the scope and nature of these naturally caused variations in population size and structure.
W70-02678

EFFECTS OF CHLORINATED HYDROCARBON INSECTICIDES ON THE FRESHWATER SEED SHRIMP,

South Dakota Univ., Vermillion.
Dr. James C. Schmulbach.

Available from the Clearinghouse as PB-188 796, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, Nov 1969. 57 p, 15 tab, 3 fig, 39 ref. OWRR Project A-015-SDAK.

Descriptors: *Insecticides, Bioassay, Crustaceans, Pesticide residues, *Pesticide toxicity, Aldrin, Dieldrin, Bioassay, Lethal limit, Water pollution effects, *Chlorinated hydrocarbon pesticides.

Identifiers: *Ostracods.

The acute toxicities of various mixtures of the two insecticides against laboratory-reared, insecticide-free ostracods were determined. The 24-hour immobility EC₅₀'s were 1.15 and 2.45 ppb for aldrin and dieldrin, respectively. Ostracods which were laboratory-reared in the presence of insecticide were also tested to determine if increased resistance or sensitivity to the chemicals had occurred by virtue of chronic exposure. Sublethal exposure to either insecticide through several generations produced populations which were more susceptible to both insecticides. In all instances, ostracods were approximately twice as sensitive to aldrin as to dieldrin. Bioassay results using combinations of aldrin and dieldrin demonstrated no synergism or potentiation with respect to the two insecticides. The phenomena of biological accumulation, storage, degradation, and elimination of aldrin and dieldrin were examined. Aldrin was consistently absorbed at a rate approximately twice that of dieldrin. Both insecticides were accumulated against a concentration gradient and stored in the ostracod body. Primary absorption of both insecticides occurred through the gut and body integument; principal storage was in the body per se, with lesser amounts being located in appendages and incorporated in or adsorbed to the shell. Aldrin was rapidly metabolized to dieldrin within the body. No metabolism of dieldrin was observed, but dieldrin was, in part, eliminated from the body when exposed ostracods were placed in insecticide-free water. A complete report of this research is contained in a Degree of Doctor of Philosophy dissertation by Joseph A. Kawatski entitled, "Toxicity and Metabolism of Two Chlorinated Hydrocarbon Insecticides (Aldrin and Dieldrin) in the Freshwater Ostracod Chlamydotheaca arcuata (Sars)." W70-02679

THE EFFECT OF THE ADDITION OF HEAT FROM A POWERPLANT ON THE THERMAL STRUCTURE AND EVAPORATION OF LAKE COLORADO CITY, TEXAS,

Geological Survey, Washington, D.C. Water Resources Div.

For primary bibliographic entry see Field 02D.

W70-02703

INFLUENCE OF STARVATION ON SELECTED TEMPERATURE OF SOME SALMONIDS,

Carleton Univ., Ottawa (Ontario). Dept. of Biology.

M. Yaqub Javaid, and John M. Anderson.

Journal, Fisheries Research Board of Canada, Vol 24, p 1515-1519, 1967. 1 fig, 16 ref.

Descriptors: Temperature, *Atlantic salmon, *Brook trout, *Rainbow trout, Salmonids.

Identifiers: *Starvation, *Temperature selection.

Starvation was observed to cause changes in the selected temperature of Atlantic salmon, brook trout, and rainbow trout. Fingerlings 2-3 inches in length were acclimated for one month at 20 deg C before 50 fish of each species were isolated. Starva-

tion periods were 22 days, 20 days, and 15 days for salmon, brook trout, and rainbow trout respectively. The fish were tested in groups of 5 or 6 and tests were replicated five times with different fish in each case. In Atlantic salmon an upward shift occurred within 24-28 hours after cessation of feeding. In brook trout and rainbow trout, a downward shift occurred within 24 hours after cessation of feeding. Brook trout showed an initial overshoot. These changes were maintained statistically constant throughout the starvation period, but in all cases the selected temperature returned to its pre-starvation value within 24 hours after resumption of feeding. (Speakman-Vanderbilt)
W70-02706

EFFECTS OF SIMULTANEOUS VARIATION OF TEMPERATURE AND DISSOLVED OXYGEN ON THE RESISTANCE OF FISHES TO CONTROLLED POLLUTANTS,

Connecticut Univ., Storrs.

Walter R. Whitworth.

Research Project Technical Completion Report, Nov 1969. 2 p. OWRR Project A-003-CONN.

Descriptors: *Lead, *Fluctuating temperature, *Brook trout, Fluctuating oxygen, Water pollution effects.

Slug doses of lead administered once a day 5 days/week to brook trout exposed to simultaneous diel fluctuations of dissolved oxygen and temperature showed that concentrations of 25 mg/liter of lead reduced growth. Concentrations of 15 mg/liter had little apparent effect and concentrations of 10 mg/liter had no deleterious effects on growth. Lead levels that were effective had a greater effect (1) when oxygen fluctuated on a diel basis to 2.4 and 3.5, and (2) when temperatures fluctuated from 10.0-16.0. Short-term toxic effects of lead on brook trout, bridled shiners, blacknose dace and banded killifish, at temperatures of 10-21 C, showed (96 hr. EC₅₀) from 4 to 40 mg/liter. Oxygen consumption of bridled shiners was not significantly affected by exposures to 2 and 8 mg/liter of lead. Lead levels of approximated 15 mg/liter had no significant effects on the eggs of brook trout and American shad.
W70-02731

STUDIES ON PHOSPHOROUS TRANSFORMATIONS IN EUTROPHIC LAKES,

Connecticut Univ., Storrs.

Richard C. Tilton.

Connecticut Institute of Water Resources, Research Project Technical Completion Report, Nov 1969. 6 p, 3 ref. OWRR Project A-017-CONN.

Descriptors: *Detergent, *Microbial degradation, *Eutrophication, Lakes.

Identifiers: *Phosphate.

Phosphate has been implicated in the active eutrophication of lakes and ponds. Household and industrial detergents contribute a major portion of phosphate to waste waters. Detergent phosphate enters the water as longchain linear and cyclic phosphate and in such form may not be available for use by algae and green plants without prior bacterial decomposition. Twenty five detergents were analyzed by cellulose thin layer chromatography (TLC) for phosphate compounds and these detergents were subdivided into five major groups depending on the particular phosphates present. Representatives of the major groups were used as sole phosphorous sources for each of eleven species of aquatic bacteria. Phosphorous degradation products were determined by TLC. Data indicated that the ability to decompose detergent phosphates depended upon the species of bacterium tested. Some bacteria utilized pyrophosphate, tripolyphosphate, tetrapolyphosphate and trimetaphosphate as phosphorous sources and excreted large amounts of orthophosphate into the medium, while others failed to grow on these complex phosphorous sources. Results suggested that

aquatic bacteria play a significant role in the decomposition of detergent phosphate in waste water and to a large extent in the aquatic phosphorous cycle.
W70-02747

CORRELATION OF STRUCTURE VS ACTIVITY OF POLLUTANTS OF FRESH WATER,

Rhode Island Univ., Kingston. Dept. of Pharmacy.

Howard W. Bond, and George C. Fuller.

Technical Completion Report, Rhode Island Water Resources Center, 1969. 16 p. OWRR Project A-021-RI.

Descriptors: *Thiol affinity-sulphydryl-reactive agents, *Sulphydryl-thiol affinity-rate assay, *Cysteine-B-nitrostyrene interaction, UV spectrophotometry-reaction monitoring, *Molluscs.

Identifiers: *Sulphydryl reactivity, *Oxygen uptake inhibitions, *Cysteine, *B-Nitrostyrenes.

Thirty-one B-nitrostyrenes were tested for their toxicity to the fresh water snail, *Australorbis glabratus*. All were highly toxic, with B-nitrostyrene itself being the most toxic. Inhibition of oxygen uptake was significantly ($P < 0.05$) correlated with sulphydryl reactivity of the derivatives studied. Homogenate oxygen uptake inhibition was associated with reduced tissue sulphydryl content. Preincubation of homogenates with cysteine antagonized the effect of B-nitrostyrene on oxygen uptake. Saturation of the B-nitrostyrene nitroolefinic bond resulted in a product (1-phenyl-2-nitroethane) with diminished ability to inhibit oxygen uptake, as well as reduction of sulphydryl reactivity. These data indicate that the effect of the B-nitrostyrenes on oxygen uptake is mediated through an interaction between the B-nitrostyrene and tissue sulphydryl material.
W70-02753

ECOLOGY OF SELECTED AQUATIC BACTERIA IN THE SNAKE RIVER,

Washington State Univ., Pullman.

Charles H. Drake.

Available from the Clearinghouse as PB-188 934, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, Washington Water Resources Research Center, Dec 1969. 12 p, 3 tab. OWRR A-018-Wash.

Descriptors: *Aquatic microbiology, *Water quality, *Bioindicators, *Pseudomonas, *Sulfur bacteria, Water pollution sources, Idaho, Washington.

Total counts and counts of selected bacterial genera were made on water samples from the Snake River above and below the Lewiston-Clarkston area. Fluorescent species of *Pseudomonas* were found to be an important part of the natural aquatic flora with their numbers approximately doubling below the urban area. Counts were made by the Most Probable Number method on a selective medium with positive tubes determined by fluorescence under long-wave ultraviolet light. Numbers of the sulfate reducing anaerobic *Desulfovibrio*, present in the water from bottom scour, were also determined. Because of the high sulfate content of the water, there was no increase in numbers below the two cities as compared to upstream samples. Total counts on standard plate count agar seemed to mostly detect extraneous non-aquatic species needing high concentrations of organic foods. Counts on the low-nutrient concentration Henrici's agar gave up to 20-fold higher counts. On this medium, *Sphaerotilus* was detected below but not above the two cities. Indications were that neither phosphate nor fixed nitrogen were limiting factors for the bacterial population. Counts of most species were lowest during the summer when the river water is primarily long-impounded water, from power dams, which has been exhausted of nutrients.
W70-02762

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

PHYTOPLANKTON FLORA OF NEWFOUND AND WINNISQUAM LAKES, NEW HAMPSHIRE,
New Hampshire Univ., Durham. Dept. of Botany.
G. K. Gruendling, and A. C. Mathieson.
Rhodora, Vol 71 (787): p 444-447, 1969. 42 fig.
117 ref. OWRR Project A-010-NH.

Descriptors: *Algae, *Trophic levels, Aquatic environment, Water quality, Nutrients, Northeast U.S., Ecological distribution, Biological indicators, New Hampshire.

Identifiers: *Newfound Lake, *Winnisquam Lake, Water and plants, Water pollution effects, Ecology, Water quality characterization.

A total of 185 taxa of fresh water algae (primarily phytoplankton) were identified at Winnisquam (partially eutrophic) and Newfound (Oligotrophic) lakes. Of the 142 taxa recorded at Winnisquam Lake 85 were found exclusively at this location. The green algae contributed the greatest number of species, but the bulk of the standing crop was composed of blue-green algae. A total of 100 taxa were recorded at Newfound Lake, and 43 of these were found exclusively at Newfound Lake. The largest number of species were green algae. During the summer the phytoplankton flora at Winnisquam Lake was primarily composed of members of the Chlorophyceae and Cyanophyceae. Members of the Bacillariophyceae, Chrysophyceae and Chlorophyceae (mainly desmids) contributed the largest number of species during the spring and fall. Diatoms were the major component of the winter flora. The summer and fall flora at Newfound Lake was primarily composed of members of the Cyanophyceae, Chlorophyceae (especially desmids) and Chrysophyceae. The diatoms and golden-brown algae contributed the largest number of species during the winter and spring.

W70-02764

PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
Louisiana Water Resources Research Inst., Baton Rouge.

Daniel H. Stern, and Michele Stern.

Available from the Clearinghouse as PB-188 915, \$3.00 in paper copy, \$0.65 in microfiche. Technical Report TR-4, La Water Resources Research Inst., Sept 1969. 60 p, 2 fig, 47 tab, 33 ref. OWRR Project A-019-LA.

Descriptors: *Limnology, *Chemical properties, *Ammonia, *Coliforms, *Phytoplankton, *Zooplankton, *Lake Pontchartrain, Saline lakes, Storm runoff, Physical properties, Nitrification, Nitrates, Dissolved oxygen, Turbidity, Phosphates, Nutrients, Water sports.

Preliminary and intensive studies from November 1968 to July 1969 showed that the discharge of storm water into Lake Pontchartrain, Louisiana affects the water quality and bio-rhythms of aquatic microorganisms. Especially after heavy rains in Orleans Parish, the presence of coliforms renders the nearshore water and beaches unsafe for some water sports. Storm drainage from Jefferson Parish also supplies coliforms that are transported to the New Orleans shoreline. Phosphates, nitrates, and nitrites nourish and bring about increases in phytoplankton and bacteria. Lake sediments, stirred up by wind waves and during heavy rains, increase the turbidity; the reduced light available for photosynthesis results in the death of phytoplankton, which add to the bottom organic materials and subsequently furnish food for more planktonic growth, and thus hastens the filling of the lake. The use of total instead of fecal coliform counts does not give the true degree of pollution because no consistent relationship was found between the two. Recommendations include: counting of fecal coliforms to determine water quality; prohibition or discouragement of swimming, skiing, and other primary water sports at certain beaches after summer rains; careful regulation of proposed chlorination of storm water owing to presence of ammonia, which retards

the disinfection process, and because of unreacted chlorine, which will disrupt the natural food chain; and basin-wide cooperation to prevent or reduce further pollution.

W70-02766

ALGAE IN RELATION TO MINE WATER,
West Virginia Univ., Morgantown. Water Research Inst.

H. D. Bennett.

PB-188 906. West Virginia Water Research Institute, Journal Report 1, (Reprint from Castanea Vol 34, No 3, p 306-328, Sept 1969). OWRR A-007-WVA.

Descriptors: *Algae, *Acid mine water, *Habitats, *Environmental effects, *Limiting factors, Benthic flora, Benthos, Mine water, Water pollution, Water pollution effects, Acid streams, Mine drainage, Chlorophyta, Chrysophyta, Euglenophyta, Cyanophyta, Diatoms, Aquatic habitat, Population. Identifiers: *Cytological effects, Algal population.

An annual cycle of bimonthly sampling was done to obtain information on species of algae tolerant to acid mine water and on chemical factors related to ecology of algae. Nitrate, phosphate, and calcium appeared not to be limiting or modifying. Correlation was lacking between factors except acidity, iron, and pH. A range for these characterized each habitat, and they appeared controlling on algal population in more-acid streams. The total number of genera and species compared favorably with numbers reported from 'unpolluted' waters. Nearly half the total species found in more-acid streams equally were in less-acid creeks, rivers, and ponds. Algae characteristic of mine water were those common to the other habitats. Reduction in numbers of species at higher acidity and lower pH was primarily in species less common to a range of habitats. The range of acidity and pH at a site is characterized by a range in species number and abundance a change in abundance being dependent on the species. Some such as *Euglena mutabilis* Sch., *Eunotia tenella* (Grun) Cleve, and *Pinularia braunii* (Grun) Cleve are most abundant in mine-polluted water. (Dodson-West Virginia)

W70-02770

PHYTOPLANKTON POPULATIONS IN RELATION TO TROPHIC LEVELS OF LAKES IN NEW HAMPSHIRE, U.S.A.

New Hampshire Univ., Durham. Dept. of Botany.
G. K. Gruendling, and A. C. Mathieson.

Available from the Clearinghouse as PB-188 912, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, University of New Hampshire Water Resources Research Center, Research Report No. 1, June 1969. 81 p, 15 fig, 9 tab. OWRR Project A-010-NH.

Descriptors: *Algae, Aquatic environment, *Aquatic algae, Water quality, *Trophic levels, Nutrients, Northeast U.S., Ecological distribution, Frequency distribution, Population, Biological indicators, New Hampshire.

Identifiers: Plant growth, Water and plants, Water pollution effects, Ecology, Effects of pollution, Water quality control, Winnisquam Lake, Newfound Lake.

The relationship between composition, periodicity and abundance of phytoplankton species and the trophic status of two New Hampshire lakes (Winnisquam and Newfound) were investigated. Newfound Lake is oligotrophic, while Winnisquam is undergoing rapid eutrophication. The differences in the total standing crop at the two lakes were related with their differences in nutrient concentrations. Orthophosphate appeared to be the primary limiting factor of algal growth at Newfound Lake, while light, temperature and possible extracellular products were the primary limiting factors at Winnisquam Lake. A discussion of the factors influencing the periodicity, abundance and distribution of phytoplankton species at the two lakes is presented, and the results are compared with previous

findings. The species composition at the lakes was dependent upon their trophic status. Dominant species were considered to be the best indicators of trophic levels. A summary of possible rare indicator organisms is also included. The phytoplankton quotients proposed by various authors were applied to the lakes. Most of the indices correctly designated the eutrophic lake, but not the oligotrophic one.

W70-02772

PROCEEDINGS OF THE EUTROPHICATION-BIOTIMULATION ASSESSMENT WORKSHOP.

California Univ., Berkeley. Sanitary Engineering Research Lab. and Pacific Northwest Water Lab. Corvallis, Oreg.

For primary bibliographic entry see Field 05A.

W70-02775

STRUCTURAL CHARACTERISTICS OF BENTHIC ALGAL COMMUNITIES IN LABORATORY STREAMS,

Oregon State Univ., Corvallis. Dept. of Botany.

C. David McIntire.

Ecology, Vol 49, No 3, p 520-537, 1968. 5 fig, 6 tab, 31 ref.

Descriptors: *Benthic flora, *Algae, *Biological communities, *Laboratories, *Streams, Light intensity, Currents (Water), Velocity, Diatoms, Seasonal, Biomass, Pigments, Productivity, Periphyton, Chlorophyta, Chrysophyta, Cyanophyta, Sampling, Phytoplankton, Organic matter, Chlorophyll, Dynamics, Temperature, Silts, Standing crop, Ecology, Photosynthesis, Respiration, Carbon dioxide, Nutrients, Dissolved oxygen, Lotic environment.

Identifiers: Species diversity, Autecology, Morphology, Export losses, Chemosynthesis, Abundance.

Effects of light intensity and current velocity on species composition and ecological properties of benthic algal communities were investigated in laboratory streams. Of 15 diatom taxa studied, only *Melosira varians*, *Meridion circulare*, and *Navicula radiosaria* were more abundant in streams receiving 700-foot-candle illumination than in those receiving 150-foot-candle. *Achnanthes exigua*, *A. minutissima*, *Meridion circulare*, *Rhoicosphaera curvata*, and *Navicula radiosaria* were indifferent to current velocity, which had positive effect on abundance of *Nitzschia linearis*, *Achnanthes lanceolata*, *Navicula cryptocephala*, *N. minima*, *N. seminulum*, *Synedra ulna*, *Gomphonema parvulum*, *G. angustatum*, *Cocconeis placentula*, and the lanceolate *Nitzschia*. *Melosira varians* exhibited negative response to current velocity; six taxa other than diatoms, *Anabaena variabilis* and *Tribonema minor* were more abundant in streams with higher light intensity, but only one species, *Phormidium retzii*, was more abundant in streams with current than in standing water. At a particular season, light intensity, and current velocity—laboratory stream conditions—allow establishment of algal communities with comparatively unique species composition and characteristic biomass, pigment concentration, and increment of export. To understand factors influencing productivity in these communities, some knowledge is necessary of autecologies of community constituents, and mechanisms regulating species composition and floral diversity. (Jones-Wisconsin)

W70-02780

SOME FACTORS AFFECTING RESPIRATION OF PERIPHYTON COMMUNITIES IN LOTIC ENVIRONMENTS,

Oregon State Univ., Corvallis. Dept. of Botany.

C. David McIntire.

Ecology, Vol 47, No 6, p 918-930, 1966. 2 fig, 6 tab, 18 ref.

Descriptors: *Respiration, *Periphyton, *Ecosystems, *Lotic environment, Metabolism.

Effects of Pollution—Group 5C

Velocity, Dissolved oxygen, Temperature, Primary productivity, Biomass, Photosynthesis, Currents (Water), Circulation, Diatom, Chlorophyta, Bacteria, Rotifers, Tension, Diffusion, Oregon, Water pollution effects, Diptera, Midges.

Identifiers: Substrate, Willamette Valley (Oregon), Stigeoclonium, Oedogonium, Tribonema minor, Melosira, Achnanthus, Anabaena, Phormidium retzii, Epithemia, Navicula, Cocconeis, Fragilaria, Closterium, Rhopalodia gibba, Ciliates, Synedra ulna.

Using laboratory streams, a respirometer chamber, and a Gilson differential respirometer, periphyton respiration in lotic environments was studied. Respiration rates expressed on an ash-free dry weight basis, determined for sections of intact communities in air-saturated water, varied between 0.8 milligrams oxygen per gram/hour at 7.2°C and 2.3 milligrams oxygen/gram per hour at 18.6°C for a community grown at current velocity of 38 centimeters/second, and between 0.4 milligrams at 7.2°C and 1.7 milligrams at 18.5°C for a community grown in current of 9 centimeters/second. These values agreed with rates obtained manometrically in Warburg experiments and values reported in literature. Periphyton developed in swifter current exhibited greater metabolic response to shaking than material grown in slow current. Fast-current communities usually had higher respiratory rate than slow-current. Respiration rates in both decreased when dissolved oxygen concentration was below air saturation, indicating sessile lotic communities were particularly susceptible to oxygen exhaustion in vicinity of respiring cells. Enhancement of respiration with increasing oxygen tension over air saturation was more pronounced at 5°C than at 13°C. Oxygen concentrations over air saturation had greater effect on respiration when flasks were unshaken. (Jones-Wisconsin)

W70-02781

KINETICS OF NUTRIENT-LIMITED GROWTH, Gulbenkian Inst. of Science, Oeiras (Portugal). Lab. of Microbiology.

N van Uden.

Annual Review of Microbiology, Vol 23, p 473-486, 1969. 60 ref.

Descriptors: *Kinetics, *Nutrients, *Growth rates, Microbiology, Reviews, Diffusion, Yield equations, Metabolism, Yeasts, Water pollution effects, Cycling nutrients, Biomass.

Identifiers: *Microbial growth, *Kinetic theory, *Nutrient limited growth, Michaelis-Menten equations, Monod equation, Saccharomyces cerevisiae, Glucose transport, Candida utilis, Aerobacter aerogenes, Xylitol transport, Escherichia coli, Aerobacter cloacae, Hydrogenomonas, Thiobacillus neapolitanus, Debaryomyces subglobosus, Competitive inhibition, Transport-limited growth, Apparent diffusion, Specific maintenance rates, Energy metabolism, Microbial populations, Nutrient concentrations, Chemostats, Continuous culture, Balanced growth, Diffusion coefficients, Specific death rates, Heterotrophy.

Specific growth rate response of an exponentially growing microbial population to variations in concentration of an essential nutrient, present in non-toxic amounts, indicates that this nutrient limits growth. Microbial growth in chemostats and in open seas are examples of nutrient-limited growth. This publication reviews 60 papers, dated 1942-1969, bearing on the development of kinetic equations to define and describe such growth. 43 equations are presented relating to nutrient-limited growth of microbial populations distributed among the following areas of consideration: fundamental relationship; Michaelis-Menten transfers, including transport-limited growth and competitive inhibition; diffusion transfer, including true and apparent diffusion; and relationship of yield factors (here defined as the sum of biomass and metabolite production) to specific maintenance rate, to parameters of energy metabolism, and to maintenance analysis. Kinetics reviewed are valid for steady-state growth in chemostats, where specific

growth rate is often well approximated by the dilution rate of the chemostat. While the equations are useful, none of them constitute a theoretically sound base for development of a kinetic theory of nutrient-limited microbial population growth. While examples are chosen from among the heterotrophic bacteria and yeasts, it appears that equations are equally applicable to algal growth, although not so stated. (Eichhorn-Wisconsin)

W70-02783

CLADOPHORA GLOMERATA AND CONCOMITANT ALGAE IN THE RIVER SKAWA. DISTRIBUTION AND CONDITIONS OF APPEARANCE,

Wyzsza Szkoła Rolnicza, Olsztyn-Kortowa (Poland). Katedra Botaniki.

Henryk Chudyba.

Acta Hydrobiologica, Vol 10, No 1-2, p 39-84, 1968. 27 fig, 12 tab, 82 ref.

Descriptors: *Cladophora, Algae, Aquatic algae, Aquatic microbiology, Aquatic productivity, Chlorophyta, Gonophyta, Diatoms, Environmental effects, Limnology, Ecology, Ecological distribution.

Identifiers: *Skawa River (Poland), Montane river course, Carpathian submontane region, Gradients (River), Thalli, Schizomycetes, Cyanophyta, Fungi, Bacillariophyceae, Charophyta, Rhodophyta.

Results of 137 samples collected during September 1-27, 1963 from the River Skawa, Poland, indicated that two groups can be distinguished by thalli: C glomerata rheobenthicum from places with current; C glomerata limnobenthicum from places with no current. The thalli appeared yellow or brown as a result of attached diatoms. The rapidity of current did not play any significant role in formation of the community of accompanying algae. Epiphytes were mainly diatoms, followed by green and blue-green algae. Pennatae diatoms were most common; Navicula and Nitzschia were the most common genus. Groups of algae accompanying C glomerata at all sampling places form one type of community and a single phytocenose with a similar floristic composition and structure. (Fitzgerald-Wisconsin)

W70-02784

CONTRIBUTIONS TO THE KNOWLEDGE OF NITROGENOUS COMPOUNDS AND PHOSPHATE IN THE LAKE WATERS OF JAPAN,

Tokyo Imperial Univ. (Japan). Geographical Inst.

Shinkichi Yoshimura.

Proceedings Imperial Academy of Japan, Vol 8, No 3, p 94-97, 1932. 1 tab, 3 ref.

Descriptors: *Eutrophication, *Nutrients, *Nitrogen, *Phosphorus, Ammonium, Nitrate, Nitrite, Organic nitrogen, Phosphate.

Identifiers: Lake types, Japan.

The amounts of ammonium-nitrogen, (nitrate+nitrite)-nitrogen, albumoid ammonium and soluble phosphate in the waters of 34 Japanese lakes, varying in trophic states, are tabulated. No determination of total nitrogen was made. The general order of each of the constituents measured was: eutrophic greater than mesotrophic greater than oligotrophic. There was little relationship between inorganic nitrogen and soluble phosphate content of the waters. The average nitrogen content (milligrams/liter) was 0.2, 0.2-0.1 and 0.1-0.0 for eutrophic, mesotrophic and oligotrophic lakes, respectively. The corresponding average phosphate contents were 0.1, 0.1-0.05 and 0.05-0.0. The total nitrogen and phosphate contents were constant throughout the year. Shallow lakes were turbid and yellow-colored and high in nitrogen and phosphate while deep lakes were clear and low in nitrogen and phosphate. (Keeney-Wisconsin)

W70-02788

MEASURING ORGANIC MATTER RETAINED BY AQUATIC INVERTEBRATES,

Georgia Univ., Sapelo Island. Marine Inst.

R. E. Johannes, and Masako Satomi.

Journal Fisheries Research Board of Canada, Vol 24, No 11, p 2467-2471, 1967. 1 tab, 14 ref.

Descriptors: *Organic matter, *Invertebrates, *Aquatic animals, Energy, Metabolism, Carbon, Respiration, Rates, Retention, Diatoms, Georgia.

Identifiers: Assimilation, Growth, Ingestion, Release, Palaeomonetes pugio, Nitzschia closterium, Sapelo Island (Georgia).

A parameter of energy metabolism by aquatic invertebrates is determined by subtracting the total rate of release of particulate and dissolved organic carbon from input rate of organic carbon in food. This is a measurement of what might be termed retention of organic carbon: the rate at which ingested organic carbon is retained by the animal for growth and respiration. Calculation of this rate requires no knowledge of what fraction of the release products is undigested food and what fraction is derived from assimilated material. Regardless of origin of organic release products, they represent a loss to the animal. This total loss subtracted from food input constitutes the real measure of the organic carbon ingestion rate:total organic carbon release rate is calculated, it can be seen that this value also equals organic carbon assimilation rate:release rate of assimilated organic carbon. Thus, retention will always be less than assimilation. Determination of organic carbon retention by Palaeomonetes pugio, feeding on the diatom, Nitzschia closterium, is reported. (Jones-Wisconsin)

W70-02790

PHOSPHORUS EXCRETION AND BODY SIZE IN MARINE ANIMALS: MICROZOOPLANKTON AND NUTRIENT REGENERATION,

Georgia Univ., Sapelo Island. Marine Inst.

R. E. Johannes.

Science, Vol 146, No 3646, p 923-924, Nov 1964. 1 fig, 13 ref.

Descriptors: *Phosphorus, *Size, *Marine animals, *Microorganisms, *Zooplankton, *Nutrients, Weight, Biomass, Metabolism, Spectrophotometry. Mussels, Amphipoda, Oxygen, Benthic fauna, Invertebrates, Crustaceans, Nannoplankton, Phosphorus radioisotopes.

Identifiers: *Excretion, *Regeneration, Phagotrophic flagellate, Tridaena crocea, Penaeus setiferus, Crassostrea virginica, Modiolus demissus, Uca pugnax, Salpa fusiformis, Littorina irrorata, Lembos intermedium, Artemia salina (Nauplii), Euplates vannus, Uronema, Calanus finmarchicus, Ciliates, Release processes, Acartia clausii.

Animal excretions are a major source of plant nutrients in the sea. The microzooplankton, not retained by plankton nets, are often overlooked by marine ecologists and their role in nutrient cycles has never been evaluated. Examinations of unfiltered water samples reveal that microzooplankton may often constitute a considerable fraction of the total animal biomass. The smaller the animal the greater the metabolic rate per net weight. Nutrient excretion rate of microzooplankton should, therefore, be higher than that of net zooplankton per unit weight. Excretion rates are defined as the period an animal requires to release an amount of dissolved phosphorus equal to its total phosphorus content, referred to as the 'body-equivalent excretion time.' Research indicated that the ratio of oxygen consumed to phosphorus excreted decreases markedly with decreasing animal size. Lack of parallelism between these two physiological processes deserves investigation. In marine animals the rate of excretion of dissolved phosphorus per unit weight increases as body weight decreases. Consequently microzooplankton may play a major role in planktonic nutrient regeneration. (Jones-Wisconsin)

W70-02791

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES,

Ontario Water Resources Commission, Toronto, Div. of Research.

M. G. Johnson, M. F. P. Michalski, and A. E.

Christie.

Ontario Water Resources Commission, Division of Research Publication No 30, (1968). 44 p, 6 fig, 5 tab, 15 ref, append A, B, C.

Descriptors: *Algae, *Analytical techniques, *Aquatic algae, Aquatic microbiology, Aquatic microorganisms, Aquatic plants, Aquatic productivity, Balance of nature, Bioassay, Chlorophyta, Cyanophyta, Diatoms, Environmental effects, Essential nutrients, Eutrophication, Bicarbonates, Carbon, Carbonates, Carbon cycle.

Identifiers: *Acid mine water, *Nutrient requirements, *Pollutants, Inhibition, Limnology, Acidity, Acid soils, Acidic water, Acids, Photosynthesis, Photosynthetic oxygen, Physiological ecology, Phytoplankton, Plankton, Pollution abatement, Pollutant identification, Water pollution control, Water pollution effects, Water pollution sources.

Studies were carried out during 1965 through 1967 on three northern Ontario lakes; two (Quirk and Pecors Lakes) were contaminated by quantities of free mineral acidity from uranium milling wastes and one (Dunlop Lake) was unaffected. Differences in chemical composition in the affected lakes, including low pH values and increased concentrations of sulfate ion, nitrate ion, and calcium ion were directly related to processes for the extraction of uranium and subsequent treatment of wastes. Nitrates were in greater supply in the contaminated lakes than in Dunlop Lake, while phosphorus and silica occurred in similar concentrations in all three lakes. Lower phytoplankton populations and indices of diversity were found in Quirk and Pecors Lakes than in Dunlop. Average primary productivities in the three lakes were 126, 71 and 34 milligrams carbon/square meter per day, respectively. In situ areal and volumetric measurements in laboratory and field bioassays confirmed the importance of inorganic carbon in limiting primary productivity. Authors concluded that inorganic carbon limits primary productivity in the lakes contaminated by acid mine wastes. However, they did not separate the effects of reduced pH alone from the effects of reduced inorganic carbon in arriving at that conclusion. (Fitzgerald-Wisconsin)

W70-02792

SOME EFFECTS OF CURRENT VELOCITY ON PERIPHERYON COMMUNITIES IN LABORATORY STREAMS,

Oregon State Univ., Corvallis. Dept. of Botany. C. David McIntire.

Hydrobiologia, Vol 27, No 3-4, p 559-570, 1966. 4 fig, 11 ref.

Descriptors: *Currents (Water), *Velocity, *Periphyton, *Laboratories, *Streams, *Ecosystems, Biomass, Diatoms, Organic matter, Chlorophyll, Standing crop, Export, Productivity, Protozoa, Cyanophyta, Chlorophyta, Chrysophyta, Aquatic insects, Water pollution effects.

Identifiers: Substrate, Stigeoclonium, Oedogonium, Tribonema, Colonization rate, Achanthales lanceolata, Navicula, Synedra ulna, Melosira varians, Phormidium tenue, Anabaena, Cocconeis placentula, Rhoicosphenia curvata, Ciliates, Baetis, Chironomus.

Some effects of current at velocities of 9 and 38 centimeters/second, on periphyton communities as determined in laboratory streams, are described. The communities, developing on the substrate, were seeded naturally by organisms entering through the water supply. The colonization proceeded in the following order: small diatoms, large diatoms, cyanophytes, ciliates, and finally chlorophytes, the last only in the slower stream. The diatom community developing in the faster current formed a dense, felt-like growth on the gravel and rubble substrate, and usually appeared

dark green or brownish. At the slower current velocity, the community was dominated by species of Stigeoclonium, Oedogonium, and Tribonema, forming long, loose oscillating filaments on the substrate and resembling aggregations of green filamentous algae, often observed in ponds. Although accumulation of biomass on the gravel and rubble was much more rapid in the fast current than slow current, organic matter per unit area of substrate was approximately equal at both velocities at conclusion of the experiment. The export of biomass was consistently greater from the community subjected to the faster current, and at biomasses nearly constant or at steady state, the highest productivity was maintained at the faster velocity. (Jones-Wisconsin)
W70-02794

NUTRIENT-PHYTOPLANKTON RELATIONSHIPS IN EIGHT SOUTHERN ONTARIO LAKES,

Ontario Water Resources Commission, Toronto, Div. of Research.

A. E. Christie.

Ontario Water Resources Commission, Div of Research Publication No 32, Oct 1968. 37 p, 10 fig, 7 tab, 23 ref.

Descriptors: *Algae, *Phytoplankton, *Nutrients, *Phosphorus, *Nitrogen, *Alkalinity, Lakes, Productivity, Phytoplankton.

Identifiers: *Ontario, *Canada, Kushog Lake (Ontario), Twelve Mile Lake (Ontario), Gull Lake (Ontario), Balsam Lake (Ontario), Sturgeon Lake (Ontario), Buckhorn Lake (Ontario), Clear Lake (Ontario), Rice Lake (Ontario).

A chain of eight southern Ontario lakes was sampled from April to September 1967, approximately every two weeks, to depths commensurate with the phototrophic zone. Each lake was sampled at two sites. Analysis of all samples included suspended and dissolved solids; total alkalinity; pH; nitrate, ammonia, organic nitrogen; ortho and acid hydrolyzable (standard method's 'Total') phosphorus; algal genera (reported as areal standard units); and chlorophyll a. A few samples were analyzed for calcium, magnesium, iron, sodium, potassium, sulfate, and chlorine. One laboratory growth study on a single sample was reported where glucose, sodium bicarbonate, and a combination of the two was added to flasks containing an 'oligotrophic' lake water sample. Based on this single laboratory experiment and a positive correlation between alkalinity and algal standing crops in the other lake water samples, it was concluded that the upper relatively oligotrophic lakes contained adequate nitrogen and phosphorus, but could support greater algal crops if additional inorganic or biodegradable organic carbon were supplied. In the lower lakes the carbon was concluded to be in ample supply. It was concluded further that entry of nitrogen and phosphorus into all eight lakes should be controlled in the future. (Gerhold-Wisconsin)

W70-02795

THE OBLITERATION OF THE HYPOLIMNION,

Yale Univ., New Haven, Conn. Osborn Zoological Lab.

Edward S. Deevey, Jr.

Memorie Istituto Italiano di Idrobiologia, Suppl 8, p 39-62, 1955. 5 fig, 30 ref.

Descriptors: *Lakes, *Hypolimnion, *Eutrophication, Volume, Stratigraphy, Iron, Oxygen, Phosphorus, Oligotrophy, Sedimentation, Productivity, Diagenesis, Glaciation, Paleolimnology, Lakes, Organic matter, Climatology, History, Bathymetry, Zooplankton, Deciduous forests, Depth, Silica, Ecology, Epilimnion, Carbon radioisotopes, Pollen, Water pollution effects, Hypolimnetic oxygen deficits.

Identifiers: Morphometry, Linsley Pond (Conn), Lake Windermere (England), Biocoenosis, Tanytarsus, Chironomus, Ontogeny, Chaoborus,

Cladocera, Bosmina, Allometry, Pine-pollen, Grosser Ploener See (East Holstein), Tippecanoe Lake (Ind), Winona Lake (Ind), Green Lake (Wis).

Eutrophication consists of real increases in biologic productivity, conditioned by increasingly favorable climatic and nutrient conditions in early postglacial time, and halted at equilibrium levels appropriate to climatic and geochemical ecological requirements. The distinction between true (edaphic) and apparent (morphometric) trophic status is examined, and implications that morphometry of lakes changes automatically as sedimentation proceeds are considered. Ontogeny of Linsley Pond (Connecticut) and of lakes generally, showing characteristics of increasing eutrophication is considered. Quantity of organic matter produced (judging by fecal quantities in sediments) was sigmoid up to an equipibrium level, as determined geochemically. The process apparently implies eutrophication, although lakes deep and large initially, simply become less oligotrophic, whereas Linsley Pond in reaching its present state of eutrophication, passed through stages characterized by the following midge faunas: Tanytarsus to Chironomus to Chironomus-Chaoborus. This hypothesis would be invalidated if its theoretical significance if it could be shown that eutrophication was an automatic consequence of sedimental filling and in this connection, classification of lakes by chironomid fauna is uncertain. Also compared, on basis of this hypothesis, is the rate of generation of oxygen deficits (per unit area) and then volumetric estimates for Linsley Pond, Lake Windermere, and Grosser Ploener See. (Jones-Wisconsin)
W70-02797

SOME PHYSICAL AND CHEMICAL FACTORS IN THE METABOLISM OF LAKES,

Saskatchewan Univ., Saskatoon.

For primary bibliographic entry see Field 02H.

W70-02798

EUTROPHICATION AND SENESCENCE IN A GROUP OF PRAIRIE-PARKLAND LAKES IN ALBERTA, CANADA,

Joseph Kerekes, and J. R. Nursall.

International Association of Theoretical and Applied Limnology, Proceedings, Vol 16, p 65-73, 1966. 4 fig, 4 tab, 9 ref.

Descriptors: *Eutrophication, *Lakes, Hypsometric analysis, Temperature, Depth, Dissolved solids, Alkalinity, Dissolved oxygen, Benthic fauna, Oligochaetes, Plankton, Seston, Weight, Organic matter, Biomass, Surface waters, Productivity, Chemical properties, Nutrients, Volume, Turbidity, Ice, Evaporation, Hydrogen sulfide, Salinity, Water pollution effects, Diptera, Midges.

Identifiers: *Senescence, *Alberta (Canada), Morphometry, Hirudinea, Sphaeriidae, Lake area, Shoreline development, Cooking Lake (Alberta), Ninistik Lake (Alberta), Miquelon Lake (Alberta), Hasting Lake (Alberta), Antler Lake (Alberta), Seasonal effects, Canada.

Five lakes near Edmonton (Alberta), showing advanced eutrophication, are described. In lakes with separate basins, there exists definite correlation between biomass and morphometric factors. This suggests that, other factors being approximately equal, productivity is higher, if total dissolved solids (TDS) is higher, if mean depth is less, or if ratio of shoreline to area is higher. Standing stock of seston during summer in Cooking Lake is perhaps close to the maximum possible in a lake in north temperate zone under natural conditions. Its continuous algal bloom gives appearance of pea soup, and conditions are probably nearly optimal for producing a high standing stock of seston and factors influencing productivity are in 'harmony' in the meaning suggested by Rawson. TDS and alkalinity have ideal concentrations for development of plankton; the lake is large, shallow, and exposed to wind action. Remineralization of plankton is

Waste Treatment Processes—Group 5D

rapid; nutrients are returned from sediments by mixing. Essential trace elements are probably present. Long daylight hours provide excellent conditions for intensive production. Based on this study, optimal TDS and alkalinity are about 1400 and 450 parts per million, respectively. (Jones-Wisconsin)

W70-02802

OBJECTIONABLE ALGAE WITH REFERENCE TO THE KILLING OF FISH AND OTHER ANIMALS,

Michigan State Univ., East Lansing. Dept. of Botany and Plant Pathology.

G. W. Prescott.

Hydrobiologia, Vol 1, p 1-13, 1948. 6 tab, 14 ref.

Descriptors: *Nuisance algae, *Eutrophication, Cyanophyta, Lakes, Reservoirs, Scum, Nitrogen, Phosphorus, Carbonates, Temperature, Shallow water, Hydrogen sulfide, Copper sulfate, Chlorophyta, Crustaceans, Soil erosion, Sewage effluents, Farm wastes, Population, Industries, Methane, Alkalinity, Hydrogen ion concentration, Toxins, Oxygen, Decomposing organic matter, Water pollution effects, Photosynthesis, Iowa, Chlorine.

Identifiers: Hydroxylamine, Anabaena, Microcystis, Gloeotrichia echinulata, Dinobryon, Synura uvelia, Fragilaria, Tabellaria, Melosira, Synechidium, Coelosphaerium, Spirogyra, Cladophora, Diatoms, Cyclops, Gomphonema, Phormidium, Aphanizomenon flos-aquae, Lyngbya, Storm Lake (Iowa), Center Lake (Iowa), Diamond Lake (Iowa).

Most troublesome algae in lakes and reservoirs are species of cyanophytes (blue-green algae), which multiply rapidly and tend to float high in the water, forming surface scums. Upon decomposition, malodorous gases and disagreeable tastes are produced. Critical conditions arising from a superabundant growth of algae occur in lakes which are shallow, warm, and rich in nitrogen, phosphorus, and half-bound carbonates. Dense 'blooms' are particularly annoying and often cause economic loss by ruining recreational sites, spoiling drinking water, clogging sand filters, killing fish (directly or indirectly), and killing animals which drink the heavily infested waters. Experiments indicate that fish may be poisoned by products of protein decomposition, including hydroxylamine and hydrogen sulfide, which are released when dense masses of cyanophytes decay. Factors which should be taken into consideration for effective treatment of lakes with copper sulphate are listed. Advantages of applying copper sulphate by spray method are pointed out. A laboratory experiment to test the algicidal action of copper is described. Data indicate that fish can withstand much greater concentrations of copper sulphate than those needed to control algae. (Jones-Wisconsin)

W70-02803

MINERAL NUTRITION OF PHYTOPLANKTON,

Woods Hole Oceanographic Institution, Mass.

Bostwick H. Ketchum.

Annual Review of Plant Physiology, Vol 5, p 55-74, 1954. 2 tab, 126 ref.

Descriptors: *Phytoplankton, *Nutrient requirements, Ecology, Chlorella, Algae, Organic matter, Cultures, Carbon, Metabolism, Nitrogen, Phosphorus, Sulfur, Calcium, Magnesium, Potassium, Sodium, Iron, Manganese, Trace elements, Chelation, Photosynthesis, Carbon dioxide, Bicarbonates, Carbonates, Temperature, Hydrogen ion concentration, Alkalinity, Light intensity, Chlorophyta, Ions, Ammonia, Nitrates, Nitrites, Dinoflagellates, Chlorophyta, Humic acids.

Identifiers: Heterotrophic, Chemotrophic, Autotrophic, Silicon, Pediastrum boryanum, Staurastrum paradoxum, Botryococcus Braunii, Fragilaria crotonensis, Nitzschia, Asterionella gracillima, Growth factors.

Phytoplankton nutrition was studied for understanding ecological conditions for growth. Use of algal organic material as a possible food source has stimulated extensive studies of mass cultures. For comparisons of results, nutrient requirements are defined as: absolute, normal, minimum, and optimum concentrations. Optimum concentration will permit maximum growth rate, reproduction, or photosynthesis of algal populations. This is based upon the concept that an inadequate concentration may result in decreased assimilation rate and an excessive concentration may be inhibitory or toxic. Pure, or at least, unialgal cultures, are needed for this study. Most nutritional investigations have been made on algae species easy to culture which perhaps differ in nutrition and physiology from those difficult to culture. Major absolute requirements include carbon, nitrogen, phosphorus, sulphur, potassium, and magnesium; iron and manganese are required in smaller amounts, sodium is unessential and calcium requirement is contradictory. Silicon is a major requirement for diatom growth but unnecessary for other forms. Various other elements--zinc, boron, cobalt, molybdenum, and copper may be necessary as trace elements. Normal requirements of various algae are given for carbon, nitrogen, phosphorus, under certain conditions. (Jones-Wisconsin)

W70-02804

5D. Waste Treatment Processes

INFLUENCE OF pH ON THE ADSORPTION OF AROMATIC ACIDS ON ACTIVATED CARBON,

North Carolina State Univ., Raleigh. Dept. of Chemistry.

For primary bibliographic entry see Field 05G.

W70-02443

STABILIZATION OF AN ACTIVATED SLUDGE PLANT,

Consoer, Townsend and Associates, Chicago, Ill. Carl D. Wright.

Water Wastes Engr, Vol 6, No 6, p 34-36, June 1969. 2 fig, 4 tab.

Descriptors: *Activated sludge, *Design data, Efficiency, Biochemical oxygen demand, Costs.

Identifiers: *Plant upset, *Shock loads, Plant modification, Kraus process, Pleasant Hills (Pa), Sludge volume index, Return activated sludge, Waste activated sludge, Clarifiers.

An activated sludge plant (3 mgd) in Pleasant Hills, Pa., operated satisfactorily for several years then became unstable or upset. It was speculated that shock loads caused by shopping centers, motels, and home garbage grinders might be responsible. The plant was converted to the Kraus process with separate aeration of return activated sludge combined with waste digester supernatant and digested sludge solids. The digested sludge solids are converted to an extremely low index activated sludge and the ammonia nitrogen returned in the digester liquor is partially converted to nitrate. This material is introduced to the aeration tanks. The process achieves complete stabilization under shock loads. The plant was modified early in 1968 and has operated satisfactorily since that time. The cost of converting the plant was about \$15,000 total. (Ledbetter-Texas)

W70-02593

FACTOR ANALYSIS AS AN AID IN AN ECOLOGICAL STUDY OF ANAEROBIC DIGESTION,

National Inst. for Water Research, Pretoria (South Africa).

D. F. Toerien, W. H. J. Hattingh, J. P. Kotze, P. C. Thiel, and M. L. Siebert.

Water Research (J Int Assn on Wat Poll Res), Vol 3, No 2, p 129-140, Feb 1969. 2 fig, 2 tab, 13 ref.

Descriptors: *Anaerobic digestion, Aerobic bacteria.

Identifiers: *Ecological study, *Factor analysis, Eigen-values, Eigen-vectors, Matrix, Dehydrogenase enzymes, Kinase enzyme, Biotic, Abiotic.

Interrelations between characteristics of an anaerobic ecosystem by means of principal component analysis of the linear correlation coefficient matrix of these characteristics is determined and described. Principal components (factors) were obtained which presented varied characteristics of the ecosystem. The behavior of the factors during a stress period was graphically demonstrated in relation to time. A three-dimensional model yielded visual representation of the behavior of three arbitrary chosen factors in relation to one another. It was concluded that factor analysis contributes much towards the determination of the relationships between characteristics and condenses the multitude of test correlations of the ecosystem into interpretable factors. (Ledbetter-Texas)

W70-02594

THE EFFECT OF METHANE ANALOGUES ON METHANOGENESIS IN ANAEROBIC DIGESTION,

National Inst. for Water Research, Pretoria (South Africa).

P. G. Thiel.

Water Research (J Int Assn on Wat Pol Res), Vol 3, No 3, p 215-223, Mar 1969. 4 fig, 15 ref.

Descriptors: *Anaerobic digestion, *Inhibition, Hydrogen, Carbon dioxide, Gas chromatograph.

Identifiers: *Toxic substances, *Methanogenesis, Chloroform, Carbon tetrachloride, Methylene chloride, Methane analogues, Warburg flasks, Endogenous methane, Inhibitors.

Extremely low concentrations of chloroform, carbon tetrachloride, and methylene chloride can inhibit methanogenesis in anaerobic digestion. This study was prompted by similar inhibition on rumen microbiota. Along with inhibition of methanogenesis, an accumulation of hydrogen was seen. The inhibition of methanogenesis by 50% from 0.96 mg/l of chloroform, 2.2 mg/l of carbon tetrachloride, or 100 mg/l of methylene chloride may have a bearing on digester operation. The results of this study were compared with those on rumen and the possible role of extracellular hydrogen as an intermediate in anaerobic digestion was discussed. (Ledbetter-Texas)

W70-02595

PHOSPHATE REMOVAL AT FORT WORTH, TEXAS,

Federal Water Pollution Control Administration, Ada, Okla.

J. A. Horn, B. L. DePrater, and J. L. Witherow.

Water Wastes Engr, Vol, No 7, p 40-42, July 1969. 4 fig, 5 tab, 2 ref.

Descriptors: *Activated sludge, *Aeration, Design data, Dissolved oxygen, Municipal waste.

Identifiers: *Phosphate removal, *Operating data, Orthophosphates, Detention times.

The high removal of phosphates by a 30 mgd municipal waste treatment plant using activated sludge process is described. The article presents the design and operating data for the plant. Total phosphate removal for the plant averaged 84 percent. The plant has many similarities to the Rilling Plant in San Antonio, Texas, which reported high phosphate removals; however, there are several significant differences between the two plants. The marked differences are the following: (with Ft. Worth data first then the corresponding Rilling data in parentheses) primary effluent BOD in mg/l—260 (180); sludge age in days—12 (3.2); SVI in mg/l—258 (155); BOD loading in lb/day/lb of MLSS+ reaerated suspended solids—0.15 (0.43); BOD loading in lb/day/lb MLSS 0.35 (0.43); and phosphate removal in %—74 (80). Because both plants obtain high phosphorus removal, the inclusion of reaerated and the differences in sludge age

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

and BOD loading and concentrations are concluded to be within the limits of design and operation for high phosphate removal. (Ledbetter-Texas)
W70-02596

THE METHANE FERMENTATION BETWEEN MESOPHILIC AND THERMOPHILIC TEMPERATURE RANGES,
California Univ., Davis. Dept. of Civil Engineering. David J. Hills, and Edward D. Schroeder. Water Wastes Engr, Vol 6, No 7, p 46-49, July 1969. 5 fig, 1 tab, 13 ref.

Descriptors: *Anaerobic digestion, *Digestion, *Sludge digestion, Model studies, Alkalinity. Identifiers: *Methane fermentation, *Anaerobic fermentation, Laboratory models, Gas production, Volatile acids, Methane production, Mesophilic bacteria, Optimum temperature.

Raw sludge was screened and rapidly frozen to -30 deg C, then warmed as needed and fed to three 5 gal carboys used as digesters. The digesters had been seeded with mesophilic bacteria. The temperature was raised incrementally from 35 deg to 52 deg C while observing the gas production from methane fermentation. The detention period was 20 days for the digesters. The data obtained show the optimum growth temperature for mesophilic bacteria to be around 41 deg C while 42 deg C marks the upper boundary for growth. (Ledbetter-Texas)
W70-02597

COMPACT ACTIVATED-SLUDGE TREATMENT OF COMBINED PETROCHEMICAL-MUNICIPAL WASTE,
Union Carbide Corp., South Charleston, W. Va. G. W. Kumke, R. A. Conwan, and J. P. Creagh. Water Wastes Engr, Vol 6, No 5, p C.1-C.6, May 1969. 7 fig, 2 tab, 5 ref.

Descriptors: *Activated sludge, *Biological treatment, BOD, Industrial wastes, Municipal wastes, Dewatering, Design data. Identifiers: *Secondary treatment, *Aero-accelerator, Thickening, Vacuum filtration, Clarifiers, Communition, Grit removal, Primary clarification, pH adjustment, Sludge volume index, MLSS, Operating performance, South Charleston (W Va).

A four year evaluation of the activated-sludge treatment of a combined petrochemical-municipal waste in full-scale aerator-clarifier units has been completed. Performance data indicate that the removal capacity of BOD-5 from the mainly petrochemical waste at an 80 percent efficiency reaches 180 lb per day per 1000 cu ft of aeration volume. An average BOD-5 removal of 130 lb per day per 1000 cu ft was obtained. A concentration of 500 mg per L of highly active biological solids could be maintained to accomodate wide variation in wastewater strength and constituents. The effects of detention time, organic loading, and sludge age on performance were delineated. Unit modifications increased the standard oxygen-transfer efficiency to 25 percent, and operating guides were established to push the units to maximum capacity while minimizing shock effects. (Ledbetter-Texas)
W70-02600

WESTERN ELECTRIC BUILDS MODERN PLANT FOR TREATING METAL FINISHING WASTES,
Western Electric Co., Inc., Indianapolis, Ind. S. F. O'Connor, B. W. Mountjoy, Jr., and N. S. Chamberlin. Water Wastes Engr, Vol 6, No 7, p D.16-D.19, July 1969. 5 fig, 1 tab.

Descriptors: *Industrial wastes, *Copper, *Gold, Neutralization, Oxidation, Reduction. Identifiers: *Metal plating wastes, Cyanates, Hexavalent chromium, Acid-alkali wastes, Segregation of wastes, Tin, Nickel, Silver, Zinc, Sludge de-

watering, Operating experience, Oxidation-reduction potential, pH adjustment, Solids removal.

The waste treatment scheme adopted for the metal finishing wastes at the Indianapolis plant of Western Electric is described. The plant variously employs neutralization, oxidation, reduction, solids removal, and solids dewatering. The wastes come mostly from the plating shop and include rinse waters from anodizing, bright-dipping, case-hardening, chromating, cleaning, electroplating, and phosphating. Besides the metals from the plating operations (chromium, copper, gold, nickel, silver, tin, and zinc), the wastes include frequent dumps of spent acid, alkali, and cyanide baths used in the plating operations. Operating results have been excellent with the exception of the segregation of the wastes. This problem will be resolved with time. (Ledbetter-Texas)
W70-02601

THE PROTEOLYTIC BACTERIA PRESENT IN THE ANAEROBIC DIGESTION OF RAW SEWAGE SLUDGE,
National Inst. for Water Research, Pretoria (South Africa).

M. L. Siebert, and D. F. Toerien. Water Research (J Int Assn on Wat Poll Res), Vol 3, No 4, p 241-250, Apr 1969. 9 tab, 17 ref.

Descriptors: *Anaerobic digestion, Isolates, Protein, Fermentation, Nitrogen-hydrogen, Ureas, Reduction of nitrate, Cellulose, Carbohydrates. Identifiers: *Raw sludge, *Proteolytic bacteria, Identification, Bacteria typing, Sporeforming, Cocci, Media, Clostridia, Rod-shaped, Bergey's Manual, Liquefaction, Citrate, Albumin.

The occurrence and identity of proteolytic bacteria in the anaerobic digestion of raw sewage sludge were investigated. Proteolytic bacteria occurred in numbers of 65×10^6 to the sixth power/ml. A high proportion of the isolates (65%) was sporeforming bacteria, and included seven Clostridium species. Cocci comprised 21% of the isolates and consisted mainly of Peptococcus anaerobius and one isolate of Staphylococcus aureus. The remaining isolates were non-sporeforming rod-shaped bacteria and included bifid-like bacteria, Bacteroides species and Eubacterium species. (Ledbetter-Texas)
W70-02602

ANAEROBIC DIGESTION: I. THE MICROBIOLOGY OF ANAEROBIC DIGESTION (Review paper),
National Inst. for Water Research, Pretoria (South Africa).

D. F. Toerien, and W. H. J. Hattingh. Water Research (J Int Assn on Wat Poll Res), Vol 3, No 6, p 385-416, June 1969. 4 fig, 4 tab, 139 ref.

Descriptors: *Anaerobic, *Digestion, *Hydrolysis, Review methane, Carbon dioxide, Microbiology, Metabolism, Respiration, Fermentation. Identifiers: *Liquefaction, *Gasification, Methanogenic bacteria, Fatty acids, Pathways, Nutrition, Bacterial population.

Anaerobic digestion is defined as a biological process which converts organic matter to methane and carbon dioxide in the absence of oxygen. Anaerobic digestion is considered as a two-step process, acid formation (liquefaction) and gas formation (gasification). Two large, different bacterial populations must be present to reach the end point—the first group converts proteins, carbohydrates, and lipids into fatty acids by hydrolysis and fermentation and the second group converts the fatty acids into methane and carbon dioxide. Article is a review of research done on these two stages of anaerobic degradation with emphasis on bacterial populations and their nutritional and oxygen requirements. The metabolic and catabolic products along with the pathways of formation are delineated as far as is known. (Ledbetter-Texas)
W70-02603

NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-II. NITRIFICATION IN TRICKLING FILTERS,
Texas Univ., Austin. Environmental Health Engineering Research Lab.

S. Balakrishnan, and W. W. Eckenfelder, Jr. Water Research (J Int Assn on Wat Poll Res), Vol 3, No 2, p 167-174, Feb 1969. 7 fig, 2 tab, 9 ref.

Descriptors: *Nitrification, *Trickling filter, Ammonia.

Identifiers: *Raschig rings, *Berle saddles, *Specific surface, Hydraulic loading, Acclimation, Organic nitrogen.

A laboratory model trickling filter was used to study the amount of nitrification obtained. The filter had a 6-foot depth of packing with 1-inch Raschig rings and Berl saddles that were hand-packed in the ratio of 2:3. The equation used to represent the percent nitrification was first order with respect to depth but higher order for hydraulic loading. The 2 parameters of fit were derived from the data collected. An increase from 10 MGAD to 30 MGAD caused the percent nitrification to decrease from 72 to 52. A linear relation was found between the rate constant and the specific surface. Temperature is said to have a great influence on the amount of nitrification. (Ledbetter-Texas)
W70-02604

ENGINEERING ASPECTS OF WASTEWATER CONTRACTS,

Gannett, Fleming, Corddry, and Carpenter, Inc., Harrisburg, Pa.

S. I. Zack. J Sanit Eng Div, Proc Amer Soc Civil Eng, Vol 95, No SA3, Proc Paper 6602, p 465-480, June 1969.

Descriptors: *Contracts, *Financing, *Maintenance, *Management, *Sanitary engineering, Construction, Operation.

Identifiers: *Expenses, *Consultants, *Disputes, Litigation, Ordinances, Sewage service.

The engineering elements essential to the financing, construction, operation and maintenance of sewerage facilities for use by two or more parties are outlined. Among subjects covered are contract terms, conditions, and clauses in successful use which include engineering basis for jointly sharing the capacities of sewage collection and treatment facilities; and for jointly sharing of capital and annual operating and maintenance costs; and also definitions of engineering terms, regulations pertaining to conditions of wastewaters, both domestic and industrial, acceptable from the party being served, as well as how and when payments are made according to actual contracts in effect are given. The importance of scheduling payments to meet commitments are indicated and examples are cited to show how engineering factors and needs of a specific location affect the patterns of a contract. The article emphasizes that no lawyer should endeavor to write a contract without engineering consultation and that no engineer should write a contract without legal advice. (Ledbetter-Texas)
W70-02605

TREATMENT OF KRAFT MILL WASTES WITH A PLASTIC MEDIA TRICKLING FILTER,

Mississippi State Univ., State College; and International Paper Co., Mobile, Ala. Southern Kraft Div. E. J. Middlebrooks, and Frank J. Coogan. Water Research (J Int Assn on Wat Pol Res), Vol 3, No 3, p 203-214, Mar 1969. 11 fig, 2 tab, 12 ref.

Descriptors: *Trickling filter.

Identifiers: *Plastic media, *Kraft waste, *Mesophilic-thermophilic, Supplemental nutrients, Diammonium phosphate, Sodium nitrate, Anhydrous ammonia, Clarifier, Preformed filter media, Surfpac, BOD removal, COD removal, Toxic substances, pH, Kills.

A pilot plant trickling filter with preformed plastic media (Dow Chemical's Surfpac) was used to

Waste Treatment Processes—Group 5D

determine operating conditions for treating a kraft wastewater. Performance was found to be satisfactory at temperatures of 45-50 deg C. The filter plus secondary settling removed more than 60% of BOD applied (neglecting recycle) at 3.7 gpm/ft² sq of primary clarifier effluent with 2.0 gpm/ft² sq recycle. Overall treatment removed 70% of BOD. Diammonium phosphate and sodium nitrate were used as supplemental nutrients. Sufficient phosphorous in water; therefore, anhydrous ammonia most economical supplement. (Ledbetter-Texas)
W70-02606

NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES—III. DENITRIFICATION IN THE MODIFIED ACTIVATED SLUDGE PROCESS,

Texas Univ., Austin. Environmental Health Engineering Research Lab.
S. Balakrishnan, and W. W. Eckenfelder.
Water Research (J Int Assn on Wat Pol Res), Vol 3, No 3, p 177-188, Mar 1969. 13 fig, 3 tab, 15 ref.

Descriptors: *Denitrification, *Nitrogen, *Nitrates, Oxygen, Carbon, Trickling filter, Activated sludge.

Identifiers: Microbial denitrification, TOC, MLSS, Contact-stabilization-denitrification, Batch flow, Continuous flow, Anaerobic, COD.

A laboratory model of modified activated sludge units under both batch and continuous feed conditions was used to study the denitrification of wastewater. The separated sludge is held under anaerobic conditions to require the bacteria to use the oxygen from nitrates and accomplish denitrification. Rate of denitrification increased as the organic matter by TOC increased. Higher denitrification rates accompanied higher nitrate concentrations in the sludge. The presence of oxygen at a level of 6.0 mg/l prevents denitrification. A 4-hr detention at 25 deg C removes 80-90% of the total nitrogen. The process used is 'Contact-Stabilization-Denitrification.' (Ledbetter-Texas)
W70-02607

ANALOG SIMULATION OF ACTIVATED SLUDGE SYSTEMS,

Kentucky Univ., Lexington.
Carl E. Burkhead, and D. J. Wood.

J of Sanit Eng Div, Proc Amer Soc Civil Eng, Vol 95, No SA3, Proc Paper 6631, p 593-606, June 1969. 14 fig, 1 tab, 7 ref.

Descriptors: *Analog computers, *Sanitary engineering, *Sludge treatment, Design, Operation.
Identifiers: *Activated sludge process, Steady state, Transient.

Analog computer solutions of activated sludge design equations are presented for constant, shock, and periodic feed input conditions. From system responses of the aerated lagoon, extended aeration, and separate sludge wasting activated sludge systems to these different inputs, the authors draw the following conclusions: (1) the analog computer can be used to solve nonlinear differential equations for both steady-state and transient solutions; (2) operational changes caused by different plant influents, e.g., shock and periodic loads, and response comparisons of different activated sludge systems to such inputs can be determined using the analog computer; and (3) research is necessary to confirm the ability of present design expressions to describe transient changes in actual plants. (Ledbetter-Texas)
W70-02608

DESIGN PRINCIPLES OF WASTE STABILIZATION PONDS,

Nova Scotia Technical Coll., Halifax.

D. Thirumurthi.

J Sanit Eng Div, Proc Amer Soc Civil Eng, Vol 95, No SA2, Proc Paper 6515, p 311-330, Apr 1969. 8 fig, 6 tab, 22 ref.

Descriptors: *Algae, *Dispersions, *Environmental engineering, *Sanitary engineering, *Sewage treatment, *Tracers, *Water pollution, Design, Design criteria, Oxidation lagoons photosynthesis.
Identifiers: *Model tests, Dyes.

Waste stabilization ponds will be more effectively employed as pollution control systems if suitable design formula and corresponding design parameters are made available to design engineers. To accomplish this objective, an analogy has been drawn between a first-order chemical reactor and a waste stabilization pond. This analogy has resulted in the adaptation of a chemical engineering reactor design equation for designing stabilization ponds. Two design parameters, first-order BOD removal coefficient and dispersion index, were considered as the basis of the new design approach. Synthetic sewage was used to determine the BOD removal kinetics. A control pond, with tap water as the medium and sodium chloride as a tracer, was used to calculate the dispersion index. The interpretation of the results demonstrate the successful applicability of the proposed design formula. An example design problem has been worked out. (Ledbetter-Texas)
W70-02609

PRELIMINARY DESIGN OF WASTEWATER TREATMENT SYSTEMS,

Federal Water Pollution Control Administration, Cincinnati, Ohio.
R. Smith.

J Sanit Eng Div, Proc Amer Soc Civil Eng, Vol 95, No SA1, Proc Paper 6426, p 117-145, Feb 1969. 13 fig, 3 tab, 20 ref.

Descriptors: *Performance, *Sanitary engineering, *Waste treatment, *Water pollution.

Identifiers: *Expenses, *Aerators, Incinerators, Sludge drying, Vacuum filters.

A digital computer program is described for preliminary design of a nine process conventional system for treatment of domestic sewage. Volume flow, concentrations of 11 water contaminants present in the feed stream, and decision parameters for each process are supplied to the program as input. Computed output includes volume flow and concentration of each contaminant at all 20 stations within the system, capital and operating cost for each process, and total cost for the system. (Ledbetter-Texas)
W70-02610

KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION,

California Univ., Berkeley. Sanitary Engineering Research Lab.

E. J. Middlebrooks, D. Jenkins, R. C. Neal, and J. L. Phillips.

Water Research (J Int Assn on Wat Pol Res), Vol 3, No 1, p 39-46, Jan 1969. 5 fig, 1 tab, 23 ref.

Descriptors: *Activated sludge, *Denitrification.

Identifiers: *Extended aeration, *Package plant, *Comminutor, *Oxigest, Hypochlorinator sludge accumulation, VSS, MLVSS, COD, Suspended solids, Nitrogen pathways, Polysaccharide substrate removal, Cell yield.

A plant study is reported of an extended aeration package type plant (Oxigest). During the four-month period, the substrate removal rate averaged 0.09 lb COD/lb VSS-day (median 0.06). Influent COD's ranged from 160 to 2300 mg/l and the MLVSS declined steadily from 5110 to 1810 mg/l. Effluent quality remained about 16 plus or minus 8 mg/l. Suspended matter in the effluent ranged from 8 to 216 mg/l and averaged 25 mg/l (median 42 mg/l). A significant proportion of the soluble effluent COD and the activated sludge solids was a polysaccharide-like material. Nitrogen data indicated denitrification in the secondary settling tank. (Ledbetter-Texas)
W70-02611

EXPERIMENTAL PROBLEMS ASSOCIATED WITH THE TESTING OF SURFACE AERATION EQUIPMENT,
Mixing Equipment Co., Rochester, N.Y.
G. G. Landberg, B. P. Graulich, and W. H. Kipple.
Water Research (J Int Assn on Wat Pol Res), Vol 3, No 6, p 445-455, June 1969. 3 fig, 1 tab, 6 ref.

Descriptors: *Oxygenation, *Aeration, *Reaeration, *Mass transfer, Saturation, Bubbles, Dissolved oxygen.

Identifiers: *Reaeration rate, *Surface aerators, Mass transfer coefficient, Steady state, Reaeration curve, Cobalt ion, Sulfite, Standard saturation, Aerators.

The pitfalls are described in using a first order differential equation to represent the rate of oxygenation (dc/dt) in the determination of the overall mass transfer coefficient $K_{sub L} a$. Three regimes prevail in plot of $c^* - c$ (log scale) vs time; namely, time of up to 30 min or more for a hydraulic steady state to obtain, during which the slope is too flat; portion where straight line fit approximates the plot very well, where slope is $K_{sub L} a$ and the steepening part of the plot as c nears c^* . Two states of oxygen exist during aeration--finely divided bubbles and truly dissolved oxygen. $K_{sub L} a$ varies with temperature of water and air, humidity, wind velocity, and sulfate concentration. It is proposed to change base for temperature correction from 1.024 to 1.012. For accuracies of plus or minus 5% in performance, a minimum of 6 tests under varying conditions is required. This accuracy is needed for comparing aerators. (Ledbetter-Texas)
W70-02612

ENERGY CONCEPTS OF AEROBIC MICROBIAL METABOLISM,

Kentucky Univ., Lexington.
Carl E. Burkhead, and Ross E. McKinney.
J Sanit Eng Div, Proc Amer Soc Civil Eng, Vol 95, No SA2, Proc Paper 6505, p 253-268, Apr 1969. 4 fig, 7 tab, 17 ref.

Descriptors: *Activated sludge, *Energy, *Metabolism, *Microbiology, *Sanitary engineering, Enthalpy, Free energy, Thermodynamics.
Identifiers: *% Aerobic processes, *Cell yield, Cells (Biology), Substrates.

The authors investigated three different energy concepts of cell yield using synthesis data measured in mixed aerobic cultures for 15 different substrates, including, the energy-synthesis concepts of McKinney, Servizi and Bogan, and McCarty. Growth, substrate removal, and oxygen uptake measurements at 25 deg C. are correlated with various thermodynamic functions including enthalpy and free energy. Efficiency measurements based upon free energy computations agree with McCarty's results. The study results, however, conflict with the magnitude of cell yield per unit change of free energy of oxidation as estimated by Servizi and Bogan. Conclusions regarding the validity of McKinney's heat loss-cell yield relationship were not possible although the proportionality between heat of reaction and oxygen utilization was verified. This latter relationship is based upon hypothetical oxidative assimilation equations computed from the experimental data and assumed protoplasm formulations. Substrates used in the study included compounds representing the basic food substances of carbohydrates, fatty and amino acids. (Ledbetter-Texas)
W70-02613

THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTES,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.; and Metropolitan Sanitary District of Greater Chicago, Ill.
C. J. Touhill, E. C. Martin, J. E. Stein, and G. McDonnell.

J Water Pollut Contr Federation, Vol 41, No 2, Part 2, p R44-R60, Feb 1969. 14 fig, 2 tab, 5 ref.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Descriptors: *Radioactivity effects, *Effluent streams, *Municipal wastes, *Industrial wastes, Phenols, E. coli, Spores, Coliforms, Bacteriophage. Identifiers: *Cyanides, *Total counts, Chicago, Colloids, Dodecane, N-paraffins.

The effects of irradiation on cyanides, phenols, and petroleum-related components, and on the microbial populations of waste effluents, are described. They irradiated the wastes under both batch and continuous flow conditions. Cyanides in concentrations of 0.5 to 45 mg/l (as encountered by the Metropolitan Sanitary District) degraded into innocuous compounds when exposed to 174,000 r in 1 hr. A dose rate of 174,000 r/hr changed phenols to dark brown colloidal suspensions. A 99% conversion of a 1000 mg/l phenol solution required 20 hrs, but the 10 mg/l solution was 95% changed in 30 min. Petroleum-type wastes as simulated by dodecane and normal paraffinic hydrocarbons were rather resistant to radiation change. Organism kill curves showed that 250,000 rads caused the following kills: total counts, 99.995%; coliforms, 100%; enterococci, 100%; spores, 92%; and E. coli phages, 100%. (Ledbetter-Texas)

W70-02614

DOMES PROTECT TRICKLING FILTERS,

Chemung County Sewer District, Elmira, N.Y.

Richard F. Dunbar.

Water and Sewage Works, Vol 116, No 3, p 95-97, Mar 1969, 9 fig.

Descriptors: *Trickling filters, *Plastics, Freezing, Efficiencies, Maintenance.

Identifiers: *Trickling filter covers, *Plastic covers, Styrofoam, Dow Domes, Snow loads, Spiral generator, Wind uplift, Elmira, New York.

The installation of two low-profile plastic (styrofoam) dome covers on 136-ft diameter trickling filters is described. The covers will prevent freezing and will improve the efficiency of the filters. The domes (Dow Domes) were spun on a form adjacent to the filters and lifted onto the filters. Each filter was out of service only 1/2 day. The domes are designed to support snow loads and to prevent wind uplift. (Ledbetter-Texas)

W70-02615

SLUDGE DISPOSAL EXPERIENCES AT NORTH LITTLE ROCK, ARKANSAS,

North Little Rock Sewer Dept., Ark.

Jimmie M. Alford.

J Water Pollut Contr Federation, Vol 41, No 2, Part I, p 175-183, Feb 1969, 6 fig, 1 tab.

Descriptors: *Sludge disposal, *Centrifugation, *Incineration, Domestic wastes, Dewatering, Operation and maintenance.

Identifiers: *Autogenous combustion, *Centrifuge, *Primary sludge, Fluidized bed, Operating data.

The operating experience of a centrifugal dewatering and autogenous combustion sludge incinerator is described. Primary sludge is stored for 24 to 48 hours to bring solids to 9 to 10% with volatiles of 75 to 80%. Centrifuges (15 inch, 3600 rpm) dewater the sludge to from 32 to 35% solids. A fluidized sand bed incinerator, 9 ft dia, burns the sludge under autogenous combustion at 1100 deg F to 1500 deg F. The unit operates at a pressure of 5 psig and burns 1200 lb/hr of sludge cake with 1500 scfm of air. The air leaving the unit has 240 to 300 lb/hr of fly ash. Power consumption for dewatering and combustion is about 56 kw (75hp) for full load. (Ledbetter-Texas)

W70-02616

A PRIMER ON WASTE WATER TREATMENT.

Federal Water Pollution Control Administration, Washington, D.C. Office of Public Information.

Available from Superintendent of Documents, US Government Printing Office for \$0.55 a copy.

Federal Water Pollution Control Administration Report CWA-12, Oct 1969, 25 p, 16 photo.

Descriptors: *Waste water treatment, *Sewage treatment, *Water pollution control, *Reviews, Tertiary treatment, Biodegradation, Environmental sanitation, Industrial wastes, Municipal wastes, Domestic wastes, Water pollution sources, Water pollution effects, Sewage effluents.

Identifiers: Federal Water Pollution Control Administration.

Water pollution sources and effects, water pollution prevention, and waste treatment are described in a brief publication intended for use by the general public. The discussion includes methods of collecting and treating wastes, primary and secondary treatment, lagoons and septic tanks, tertiary treatment, pollutants, dilution, disposal, and a glossary. (Knapp-USGS)

W70-02638

THE EFFECT OF ELEVATED TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE,

Mississippi State Univ., State College, Dept. of Microbiology.

L. R. Brown, R. G. Tischer, C. M. Ladner, and C. D. Bostwick.

Mississippi State University Report, State College, Mississippi, July 1, 1967, 55 p, 6 tab, 26 fig. OWRR Project A-007-MISS.

Descriptors: *Temperature, *Domestic wastes, *Biochemical oxygen demand, *Chemical oxygen demand, *Biological treatment, Thermophilic bacteria, Waste water treatment, Aerobic treatment, E. coli, Pseudomonas.

Identifiers: Phosphate removal, Suspended solids.

The stabilization of normal domestic sewage at 30 deg C, 45 deg C, 55 deg C, and 65 deg C has been investigated, and it was found that suspended solids removal was essentially the same at all temperatures and averaged between 90 and 94% removal. BOD and COD removal decreased with increasing temperature, and COD removal ranged from as low as 49% at 65 deg to 70% at 30 deg. Settleable solids reduction for the 30 deg C and 65 deg C were 80% and 58%. Thermal death time studies have shown that E. coli and the enterococcus were killed within 30 minutes at 55 deg C and within 10 minutes at 65 deg C. S. paratyphi and shigella sonnei were destroyed within 14 minutes at 55 deg C and within 4 minutes at 65 deg C. There appears to be more organisms in normal domestic sewage which grow at 45 deg C than there are which grow at 55 deg C or at 65 deg C. The major objection to the effluent from the 55 deg C treatment was the turbidity caused by the bacterial population. It has been found that the treatment of the 55 deg C effluent with protozoa markedly decreases not only the turbidity of the effluent but also lowers the COD. (U-padhyaya-Vanderbilt)

W70-02710

DISCHARGE OF SEWAGE EFFLUENT FROM A LINE SOURCE INTO A STRATIFIED OCEAN,

California Inst. of Tech., Pasadena, Dept. of Civil Engineering.

Norman H. Brooks, and Robert C. Y. Koh.

International Association of Hydraulic Research, XI Congress, Leningrad, Sept 1965, 8 p, 3 fig.

Descriptors: *Sewage effluents, *Density stratification, *Oceans, Outlets, Buoyancy, Thermal pollution.

Identifiers: *Plumes.

The case of a two dimensional buoyant plume in a density stratified environment in which the density gradient is uniform is treated. The engineering practice sewage is often discharged into a long line of jets from ports along a straight diffuser pipe; after a brief period of mixing as circular jets, the individual discharges merge into a wide plume as if produced by a virtual two-dimensional source.

When the ocean is density stratified, the buoyant plume of sewage may not rise to the ocean surface because the diluted sewage in the plume becomes neutrally buoyant at an intermediate level. The solution presented here presumes vertical upward discharge, and the effects of initial momentum flux and mass flux, as well as buoyancy flux, are considered. An analysis is given, following the method of Morton, for determining the maximum height of rise of a two-dimensional plume as a function of the buoyancy, mass, and momentum fluxes at the source, and the density gradient in the ocean (assumed constant). Mass and momentum flux parameters are found to be of secondary importance compared to the buoyancy flux and density gradient. The theory is briefly illustrated by application to the design of a sewer out-fall for Seattle, Washington. (Guerrero-Vanderbilt)

W70-02714

EFFECT OF BORON ON BIOLOGICAL WASTE TREATMENT,

Delaware Univ., Newark, Dept. of Civil Engineering.

Shankha K. Banerji.

Project Completion Report, Sept 1969, 10 p, 3 tab, 1 fig, 3 ref. OWRR Project A-007-DEL.

Descriptors: *Boron, *Toxicity, *Biological treatment, Adsorption, Water quality, Sludge synthesis, Endogenous respiration.

Identifiers: *Delaware.

Water quality of waterways and wastewaters of Delaware were analyzed to determine the extent of boron in the environment. Generally, urban and semi-urban streams had higher boron levels compared to rural ones, indicating that boron may be a good tool to determine man-made pollution. Toxicity of boron in slug doses to aerobic biological waste treatment was determined by using laboratory batch activated sludge units fed with glucose and yeast extract. Using Michaelis-Menten enzyme inhibition model, it was found that the inhibition of boron to activated sludge was uncompetitive. Continuous boron dosing experiments showed that activated sludge cultures did not acclimate to boron after prolonged exposure and the corresponding toxicity of a particular boron dose was higher than that obtained in slug dose conditions. Toxicity of boron on microorganisms were manifested in respiration reactions more so than synthetic ones. Adsorption of boric acid on the clays, illite and kaolinite, and biological sludge was also determined. Significance of this adsorption lies in the fact that further concentration of the sludge after boron adsorption would increase the level of boron several fold, causing problems in subsequent operations, e.g., sludge digestion or land disposal of sludge.

W70-02734

OPTIMIZING SALVAGEABLE WATER RESOURCES IN A SEMI-ARID INLAND BASIN,

Arizona Univ., Tucson.

For primary bibliographic entry see Field 03C.

W70-02745

VIRUS REMOVAL BY CHEMICAL COAGULATION,

Illinois Univ., Urbana, Dept. of Civil Engineering.

For primary bibliographic entry see Field 05F.

W70-02767

SE. Ultimate Disposal of Wastes

DEEP WELL DISPOSAL OF WASTEWATERS IN SALINE AQUIFERS OF SOUTH FLORIDA,

J. I. Garcia-Bengochea, and R. O. Vernon.

Paper presented at 50th Annual Meeting, American Geophysical Union, Wash DC, Apr 21-25, 1969, 15 p, 4 plate, 1 tab, 7 ref.

Water Quality Control—Group 5G

Descriptors: *Injection wells, *Deep wells, *Waste water disposal, *Florida, Saline water systems, Aquifers, Groundwater movement, Brackish water, Water utilization, Reservoirs, Water storage, Research and development.

Identifiers: Belle Glade, South Florida.

A deep-well disposal system was operated for three years in the highly saline Boulder Zone of the Floridan aquifer in South Florida at Belle Glade. No trace of contamination was detected in an overlying, intermediate saline aquifer. If the hydrogeological conditions found in Belle Glade extend throughout southern peninsular Florida, an ideal situation is available for use of the deeper or Boulder Zone of the Floridan aquifer as a receiving zone of waste disposal. Groundwater flow is to the surrounding seas, discharging at considerable depth and away from shorelines. The less saline water of the upper part of the artesian aquifer can be used as a source of brackish water for future uses, or as an artificially recharged fresh-water storage reservoir. (Carstens-USGS)

W70-02468

5F. Water Treatment and Quality Alteration

POLLUTION OF DRINKING WATER.

Pa Stat Ann tit 18, sec 4640 (1963).

Descriptors: *Pennsylvania, *Potable water, *Water pollution, *Water supply, Water storage, Ponds, Dams, Reservoirs, Legislation, Legal aspects, Water pollution control, Water quality control, Public health, Control, Regulation.

Identifiers: *Penalties (Criminal).

Persons who wilfully enter enclosed land on which is erected any dam, reservoir, pond or other artificial means for storing water used by the public for drinking purposes and pollute or attempt to pollute such water are made subject to criminal penalties. Any duly constituted watchman of any water company or any constable or policeman is empowered, on seeing such a trespass, to arrest the offender and take him before a magistrate for violation of this section. (Keith-Florida)

W70-02522

INDUSTRIAL WASTES.

For primary bibliographic entry see Field 06E.

W70-02548

DOMESTIC WATER SUPPLIES.

Pa Stat Ann tit 35, secs 691.501 thru 691.503 (1964).

Descriptors: *Pennsylvania, *Water quality control, *Water supply, *Water sources, Regulation, Supervisory control (Power), Administrative agencies, Water pollution control, Water quality, Legislation, Legal aspects, State governments, Public health, Water pollution.

Identifiers: Penalties (Civil), Penalties (Criminal), Public nuisance.

The Sanitary Water Board is authorized and empowered to adopt and promulgate orders and regulations for the protection of any source of water that has been approved by the Commissioner of Health or the Department of Health for present or future supply to the public. The Board shall regulate any pollution of such water sources that may be injurious to the public health or objectionable for public water supply purposes. Violations of such orders and regulations are declared to be public nuisances, and are punishable by fine and/or imprisonment. (Sisserson-Florida)

W70-02550

IRON AND MANGANESE REMOVAL FROM SMALL GROUNDWATER SUPPLIES,
Rhode Island Univ., Kingston. Dept. of Mechanical Engineering and Applied Mechanics.

Frank J. DeLuise.

Technical Completion Report, Rhode Island Water Resources Center, 1969. 12 p, 1 tab, 4 fig, 3 ref. OWRR Project A-017-RI.

Descriptors: *Groundwater, *Iron, *Manganese, *Filtration, *Oxidation.

Iron and manganese have been removed from water solution by oxidation and filtration. Oxidation was accomplished by the addition of sodium hypochlorite or potassium permanganate, and filtration was through 0.22 micron membrane filters. The original solutions contained 2 mg/l of iron and 1 mg/l of manganese, and removals to below detection limits (0.025 mg/l iron, 0.0125 mg/l manganese) were accomplished in batch tests. Analysis was by atomic absorption spectrophotometry. Preliminary runs have been made employing this oxidation and filtration system in a flow process using a cartridge filter. Excellent removals of iron and manganese have been obtained, but excessive pressure drops need to be overcome to render the process feasible.

W70-02755

VIRUS REMOVAL BY CHEMICAL COAGULATION.

Illinois Univ., Urbana. Dept. of Civil Engineering. Richard S. Engelbrecht, and Malay Chaudhuri. Available from the Clearinghouse as PB-188 911, \$3.00 in paper copy, \$0.65 in microfiche. Final Report, Illinois Water Resources Center, Research Report No 25, Nov 1969. 66 p, 19 tab, 21 fig, 73 ref. OWRR Project A-020-ILL.

Descriptors: *Coagulation, *Flocculation, *Aluminum, Bacteriophage, Tertiary treatment.

Identifiers: Virus removal, T4, MS2, Coordination complex, Polyelectrolytes.

Using bacterial viruses (Bacteriophages T4 and MS2 against Escherichia coli) as models and aluminum as the coagulant metal ion, it was shown that removal of viruses from water by chemical coagulation and flocculation with aluminum sulfate consists of a primary reaction step which possibly results in the formation of coordination complexes between aluminum and carboxyl groups on the virus coat protein. The complexed viruses were not inactivated and active viruses could be recovered from the settled floc following their removal from water by coagulation and flocculation. The process of chemical coagulation and flocculation was found quite effective in removing bacteriophages T4 and MS 2 from water. The optimum coagulant dosages and pH values were 40 to 50 mg/l of aluminum sulfate at pH 5.24 for bacteriophage T4 and at pH 6.0 for bacteriophage MS2. The highest removals attained were 98.0 and 99.9 percent, respectively. Presence of bivalent cations like calcium and magnesium up to a concentration of 50 mg/l each did not interfere with the efficiency of the process. Organic matter like albumins, wastewater and wastewater effluent lowered the removal efficiency significantly. Commercially available cationic polyelectrolytes were found effective both as coagulant aids and as prime coagulants.

W70-02767

5G. Water Quality Control

INFLUENCE OF pH ON THE ADSORPTION OF AROMATIC ACIDS ON ACTIVATED CARBON,
North Carolina State Univ., Raleigh. Dept. of Chemistry.

Thomas M. Ward, and Forrest W. Getzen.

Environ Sci and Technol, Vol 4, No 1, p 64-67, Jan 1970. 4 p, 3 fig, 2 tab, 14 ref. PHS Grant ES-00177-02.

Descriptors: *Water pollution treatment, *Tertiary treatment, *Activated carbon, *Pesticides, *Chlorinated hydrocarbon pesticides, Aromatic compounds, Hydrogen ion concentration, Adsorption, Thermodynamics, Aqueous solutions, Pesticide kinetics, Water purification.

Identifiers: Aromatic acid removal.

Studies are reported of the adsorption on activated carbon over a wide pH range of 3 herbicides: 2,4-dichlorophenoxyacetic acid (2,4-D); 2-methoxy-3,6-dichlorobenzoic acid (Dicamba); and 3-amino-2,5-dichlorobenzoic-acid (Amiben). Equilibrium adsorption data on these and 7 other structurally related compounds fit Langmuir isotherms in the range of concentrations studied at all pH levels. There is a marked increase in the removal of all solutes from aqueous solutions on lowering the pH below 7.0. Adsorption in the acid region is greater than that expected from the molecular-ionic ratio of the bulk solution. This effect is explained in terms of an enhanced specific ion adsorption resulting from increasing proton concentration as the pH is lowered and a subsequent alteration in the surface properties of the carbon. Maximum adsorption is attained near the point where pH=pKa. At pH 3.0 approximately 50% of the herbicides in 0.0001 molar solution was adsorbed by 0.01 g of activated carbon in 4 hours. At pH 7.0, the removal generally ranged from 8-22%, and at pH 11.0, from 2.5-15%, depending on the specific herbicide present. (Knapp-USGS)

W70-02443

INTERSTATE COMMERCE - NAVIGABLE RIVERS - INDUSTRIAL WASTE CLOGGING CHANNEL HELD NOT UNLAWFUL OBSTRUCTION - UNITED STATES V REPUBLIC STEEL CORP (7th Cir 1959).

Harv L Rev, vol 73, no 6, p 1228-1231, Apr 1960. 4 p, 20 ref.

Descriptors: *Rivers and Harbors Act, *Navigable rivers, *Federal jurisdiction, *Navigation, Obstruction to flow, Legal aspects, Judicial decisions, Legislation, Regulation, Jurisdiction, Permits, Channels, Wastes, Liquid wastes, Solid wastes, Structures, Piers, Docks, Lake Michigan, Federal Government, United States, Rivers, Harbors, Barriers, Reasonable use, Industrial wastes.

Identifiers: *Interstate commerce, *Injunction (Prohibitory), Calumet River, Penalties (Criminal).

Three steel companies were enjoined, under authority of the Rivers and Harbors Act of 1899, from depositing industrial wastes in a federally maintained channel. The circuit court in United States v Republic Steel Corp., 264 F2d 289 (7th Cir 1959), reversed on the grounds that obstructions resulting from deposits of solid wastes in suspension are not prohibited and injunctive relief is limited by statute to removal of structures. There are three possible common law bases for governmental relief: the jurisdictional grant in cases in which the United States is a party; the admiralty clause; and the commerce clause. An analysis of judicial decisions in which these jurisdictional bases have been invoked indicates that the government's success or failure in invoking these bases has depended on the type of interest it sought to protect. The courts have given standing to governmental attempts to protect an interest in internal functions but have denied standing where the interest is that of the sovereign representing the rights of its people. (Keith-Florida)

W70-02512

REMARKS BY CONGRESSMAN WILLIAM C. CRAMER BEFORE THE 56TH ANNUAL CONVENTION, NATIONAL RIVERS AND HARBORS CONGRESS.

Proceedings of the 56th Annual Convention, Nat'l Rivers and Harbors Congress, p 58-60, May 13-15, 1969. 3 p.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

Descriptors: *Water resources development, *Federal budgets, *Political aspects, *Federal project policy, Project planning, Project purposes, Projects, National income, Water pollution control, Water pollution, Pollution, Water policy, Federal Government, Pollution abatement, Sewage treatment, Cost-benefit ratio, Costs, Cost-benefit theory, Cost-benefit analysis.

Identifiers: *National Rivers and Harbors Congress.

Good leadership in developing and preserving the Nation's water resources is essential to our country's future. Pollution and lack of conservation could become our most critical problem. Our pollution control programs must be upgraded. It is inexcusable that of the funds authorized for sewage treatment plant construction, only 30 percent in 1969 and 20 percent in 1970 were recommended. A new approach is being planned which would set a financing base, and the House Committee on Public Works is scheduling an investigation on the subject of updating the elements of the benefits-to-cost ratio. The Congress and the National Rivers and Harbors Congress should continue to oppose user charges. This year, additional basin authorizations will have to be considered and perhaps a two-year authorizing basis will be put on. When the Omnibus Rivers, Harbors, and Flood Control Bill is considered next year, the much needed water resources projects could possibly be included. (Smith-Florida)

W70-02513

PREVENTION OF POLLUTION.

U Det L J, vol 37, no 1, p 144-149, Oct 1959. 6 p.

Descriptors: *Michigan, *Water pollution control, *Sewage treatment, *Pollution abatement, Cities, Local governments, Regulation, Governments, Water supply, Sewers, Sewerage, Water pollution sources, Diseases, Sewage disposal, Treatment facilities, Disposal, Rivers, Streams, Costs, Financing, Government finance, Riparian rights, Planning, Resource development, Reasonable use, Administrative agencies.

The use of surface and groundwater for drinking or potable purposes is not always compatible with the disposal of domestic and industrial waste to the same source. There is a need for planning and regulation of the use of our water resources. Although the doctrine of riparian rights has prevailed since early times, judicial interpretations have gradually altered the meaning of the doctrine. The riparian doctrine of reasonable use is a modern source of pollution control. Such pollution control in Michigan dates back to the Civil War days. Today, the Water Resources Commission serves to control pollution. The United States Public Health Service has sponsored numerous programs of aid to municipalities under the new Federal Water Pollution Control Act. Many cities have also enacted antipollution ordinances on their own. Existing laws with public support and adequate enforcement staffs should be sufficient and adequate to abate pollution problems. However, there needs to be more inter-governmental cooperation in enforcement. Many raw sewage treatment plants have been completed or planned, but more must be done to arouse public support and to plan for future legislation and financing. (Smith-Florida)

W70-02514

WATER CONSERVATION AND RECLAMATION FUND.

Pa Const art 8, sec 16.

Descriptors: *Pennsylvania, *Water conservation, *Water reuse, *Water resources development, Legislation, Legal aspects, Water resources, Pollution abatement, Water pollution, Recreation, Financing, Construction, Sewage, Pollutants, Water quality control, Treatment facilities, Acid mine water, Mine wastes, Mine acids, Waste water (Pollution), Water pollution sources.

The State, by its constitution, is authorized to issue bonds in the amount of five hundred million dollars for a Land and Water Conservation and Reclamation Fund. The Fund will be used for the conservation and reclamation of land and water resources, for the elimination of acid mine drainage, sewage and other pollution from the streams of the state, and for providing financial assistance to state political subdivisions for the construction of sewage treatment plants, restoration of abandoned strip-mine areas, and development of park and recreational areas. (Keith-Florida)

W70-02518

POTOMAC RIVER POLLUTION.

Pa Stat Ann tit 32, sec 741 (1967).

Descriptors: *Pennsylvania, *Water pollution control, *Interstate compacts, *Interstate commissions, Interstate rivers, Water resources development, Governments, State governments, Federal government, Water policy, Water pollution, Water pollution sources, Legislation, Legal aspects, Surveys, Waste water (Pollution), Industrial wastes, Data collections, Inter-agency cooperation, Regulation, Standards, Classification, Administrative agencies, Financing.

Identifiers: Potomac River.

A commission is hereby created to act jointly with other member states on the Interstate Commission on the Potomac River Basin. The Governor is authorized to enter a compact with the other members in regard to the abatement of existing pollution and control of future pollution of interstate streams. The states of Maryland, West Virginia, Pennsylvania, and Virginia, and the District of Columbia shall comprise the Potomac Valley Conservancy District. The Commission, composed of representatives from member states, is empowered to: (1) collect and analyze data on pollution; (2) cooperate with local, state, and federal agencies in formulating rules and regulations for pollution control and prevention; (3) disseminate public information in relation to stream pollution problems; (4) make, revise, and recommend reasonable minimum standards for treatment of sewage and industrial or other wastes before discharge into the waters of the district; and (5) establish reasonable physical, chemical, and bacteriological standards of water quality satisfactory for various classifications of use. Operations of the Commission shall be financed by the United States and the member states on a pro rata basis. (Smith-Florida)

W70-02535

POLLUTION OF WATERS.

Pa Stat Ann tit 32, sec 815.31-815.35 (1967), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Delaware River Basin Commission, Boundaries (Property), Interstate rivers, *Water resources development, Water pollution control, Water policy, Interstate commissions, Administrative agencies, Planning, Legislation, Interstate compacts, Legal aspects, River basin development, River basins, Supervisory control (Powers), Delaware River, Water conservation, Pollution abatement.

Identifiers: *Intergovernmental cooperation.

The part of the Delaware River Basin lying within the boundaries of Pennsylvania is hereby declared to be a component part of an interstate region for the purpose of intergovernmental cooperation in the conservation, protection and development of water resources by means of integrated planning. The Delaware River Basin Commission is recognized as the established regional commission for such intergovernmental cooperation in this area. The Department of Health is directed to apply and carry into effect the provisions of the interstate agreement concerning control and abatement of pollution. The Department is hereby authorized to cooperate with the Commission in regard to pollution control and abatement, and in regard to

further study of the sanitary condition of the waters of the Delaware River and its tributaries. (Kelly-Florida)

W70-02538

OHIO RIVER VALLEY WATER SANITATION COMPACT.

Pa Stat Ann tit 32, secs 816.1-816.7 (1967).

Descriptors: *Interstate compacts, *Interstate commissions, *Water pollution, *Pennsylvania, New York, Illinois, Kentucky, Indiana, Ohio, Tennessee, West Virginia, River basin commissions, Ohio River, Legal aspects, Pollution abatement, River basins, State governments, Water policy, Administrative agencies, Interstate rivers, Industrial wastes, Watershed management, Watersheds (Basins), Water quality control.

This Compact was entered into by the states of Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Tennessee, and West Virginia for the purposes of abating existing pollution and controlling any future pollution in the Ohio River Drainage Basin. The Compact establishes a Water Sanitation Commission which is composed of three representatives from each of the signatory states and three from the federal government. The functions of the Commission include the study of the pollution problems of the Ohio River Valley Water Sanitation District, the submission of reports for the prevention or reduction of stream pollution, and the recommendation of appropriate legislation dealing with water pollution problems. The Compact provides a procedure by which the Commission may order any municipality, corporation, person, or other entity discharging sewage or industrial waste into the Ohio River or any other river to discontinue such discharge, and it provides that such order shall be enforced by the courts of the signatory states. (Smith-Florida)

W70-02539

POLLUTION: TRESPASS ON STATE HATCHERIES.

Pa Stat Ann tit 30, secs 200-204 (Supp 1969).

Descriptors: *Pennsylvania, *Fish conservation, *Fish hatcheries, *Water pollution control, Legislation, Legal aspects, Explosives, Poisons, Fish management, Pollution abatement, Water pollution, Permits, Natural resources, Aquatic life, Administrative agencies, Beds, Banks, Obstruction to flow, Pollutants, Civil engineering.

Identifiers: *Trespass, Penalties (Criminal), Penalties (Civil).

No person will place in any waters of the state any electricity, explosives, or poisonous substance for the purpose of catching, injuring, or killing fish. No person will allow any substance harmful to fish to enter the waters of the state in the absence of a showing that every reasonable means has been used to abate and prevent such pollution. Explosives may be used for engineering purposes if a permit for such use has been obtained from the proper national, state, or local authority. Both civil and criminal penalties are provided for violation of the foregoing provisions. It is unlawful to fish or trespass on any waters, beds, or banks of any fish hatchery controlled by the Fish Commission. It is also unlawful to willfully or maliciously damage any Commission property, or obstruct or pollute the water of any state hatchery. Criminal penalties are provided for the violation of the foregoing provisions. (Keith-Florida)

W70-02543

MISCELLANEOUS PROVISIONS (RELATING TO WATER).

Pa Stat Ann tit 30, secs 351, 361, 381, 391, 392 (1958).

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Water Quality Control—Group 5G

Descriptors: *Pennsylvania, *Water pollution, *Oysters, *Interstate compacts, Legislation, Legal aspects, Canals, Rivers, Lakes, Ponds, Streams, Clams, Fish conservation, Delaware River, New York, New Jersey, Interstate rivers, Regulation, Industrial wastes.

Identifiers: *Set-nets, Penalties (Criminal), Rivulets.

It is unlawful for any person to place a set-net across any of the canals, rivulets or creeks of the state. All persons engaged in manufacturing or hide tanning who wash ore or use vitrol in the tanning process will prepare a tank to filter out wastes to prevent those wastes from entering the waters of the state. The importation into the state of oysters and clams for sale by unlicensed non-residents is prohibited. Violation of state conservation or fish laws in that part of the Delaware River lying between Pennsylvania and New York or Pennsylvania and New Jersey may be prosecuted in the state in which the violation was committed; this section will become effective when either New York or New Jersey enacts a similar law. Criminal penalties are provided for violation of any of the foregoing provisions. (Keith-Florida)
W70-02544

INDUSTRIAL WASTES.

For primary bibliographic entry see Field 06E.
W70-02548

PETTY POLLUTION.

Pa Stat Ann tit 35, secs 691.401 thru 691.403 (1964).

Descriptors: *Pennsylvania, *Water pollution control, *Water pollution, *Regulation, Administrative agencies, Supervisory control (Powers), Permits, Water quality control, Pollutants, Explosives, Legislation, Legal aspects, Public health, Aquatic animals, Industrial water, Recreation.

Identifiers: Penalties (Civil), Penalties (Criminal), Nuisance.

It is unlawful to put or place any explosive or other substance into the waters of Pennsylvania that may be injurious to the public health, animal or aquatic life, or industrial or recreational uses of such waters. Explosives may be used in such waters if a permit for such use has been given by the proper national, state, or local authority. Violations of these provisions are declared to be public nuisances, and are punishable by fine and/or imprisonment. The Sanitary Water Board is empowered to adopt reasonable rules to prevent such pollution. (Sisserson-Florida)
W70-02549

OHIO RIVER VALLEY SANITATION COMPACT.

Ky Rev Stat Ann sec 224.190 (Supp 1968).

Descriptors: *Kentucky, *Water pollution control, *Waste disposal, *Interstate compacts, Planning, Administration, Coordination, Legislation, United States, Local governments, State governments, Interstate commissions, Water pollution sources, Water policy, Water purification, Water pollution, Sewage treatment, Solid wastes, Sewage, Sewage disposal, Industrial wastes, Water pollution effects.

The Ohio River Valley Sanitation Compact, negotiated between Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Tennessee and West Virginia, is accepted by Kentucky. The purpose of the Compact is to reduce and control the pollution of the Ohio River Valley. Each state has pledged full support and cooperation and agrees to establish the Ohio River Valley Sanitation Commission. The Commission shall consist of three members from each state and three members representing the United States Government. The guiding principle of this compact shall be that pollution by

sewage or industrial wastes originating within a signatory state shall not be allowed to injuriously affect the various users of interstate waters. All sewage or wastes shall be treated so as to remove all settleable solids and 45% of the suspended solids. The Commission shall study and recommend pollution programs directed towards the interstate pollution problem. The Commission may issue orders requiring or forbidding conduct which involves pollution, and such orders are enforceable in any court of general jurisdiction or any United States District Court. (Darragh-Florida)
W70-02571

REAERATION MEASUREMENTS IN AN ESTUARY.

Dames and Moore, New York.

David W. Julian.

ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 95, No SA6, Paper 6987, p 1165-1178, Dec 1969. 14 p, 7 fig, 5 tab, 12 ref, append.

Descriptors: *Reaeration, *Estuaries, *California, Winds, Waves (Water), Turbulence, Dissolved oxygen, Water quality, Oxygenation.

Identifiers: Sacramento-San Joaquin Delta (Calif).

Measurements of surface reaeration for the Sacramento-San Joaquin Delta were computed from observed diurnal dissolved oxygen changes in the estuary. The reaeration constants varied between 0.16 and 3.91 grams per cu m per hr at 0% saturation. Independent in-situ measurements using gasometric and disturbed equilibrium methods were conducted for comparison. Raeaeration constants varied from 0.64 to 2.84 gm per cu m per hr using the gasometric method. The disturbed equilibrium method yielded reaeration constants between 0.62 and 1.70 gm per cu m per hr. The independent methods showed reaeration constants to be highly variable. Surface turbulence proved to be the most important mechanism controlling reaeration constants in the estuary. Wind velocity was the singularly most significant parameter in causing surface turbulence. (Knapp-USGS)
W70-02636

A PRIMER ON WASTE WATER TREATMENT.

Federal Water Pollution Control Administration, Washington, D.C. Office of Public Information.

For primary bibliographic entry see Field 05D.
W70-02638

CLEANING OUR ENVIRONMENT - THE CHEMICAL BASIS FOR ACTION.

Lloyd M. Cooke.

Report available for sale from American Chemical Society, Special Issues Sales, 1155 Sixteenth St, NW, Wash DC - 20036. Price - \$2.75. American Chemical Society Report by Subcommittee on Environmental Improvement, Committee on Chemistry and Public Affairs, 1969. 249 p, 16 fig, 39 tab, 522 ref.

Descriptors: *Environmental engineering, *Pollution control, *Environmental sanitation, *Environmental effects, Air pollution, Water pollution, Water pollution control, Waste disposal, Water treatment, Air pollution effects, Pesticides, Public health, Sanitary engineering, Wastes, Water quality, Water chemistry.

Identifiers: *Environmental management, Pollution control chemistry.

The chemical aspects of air and water quality, and of environmental management in general, are discussed primarily for the involved and educated layman, particularly those involved in legislative and regulatory work. Scientists and engineers not working directly in the field of environmental management may also be interested. An objective account of the current status of the science and technology of environmental improvement is given. The information is analyzed and measures are recommended which should help, if adopted, to im-

prove conditions and accelerate technological development. A bibliography of 188 entries is included. (Knapp-USGS)
W70-02640

DETERMINATION OF SPACINGS OF PARALLEL DRAINAGE SECTIONS AND FILTER-WELL SERIES IN OPENCAST MINE DRAINAGES (GERMAN).

Lothar Richter.

Russian and English summaries. Zeitschrift fur Angewandte Geologie, Vol 14, No 8, p 420-429, Aug 1968. 10 p, 9 fig, 4 tab, 8 ref.

Descriptors: *Drainage engineering, *Drainage density, *Drainage effects, *Well filters, *Mine drainage, *Mathematical studies, Hydrogeology, Estimating, Groundwater, Water level fluctuations.

Identifiers: *Filter wells, Parallel drainage spacing.

Hydrogeological analytical methods for the practical determination of parallel filter-well bars and drainage-section spacings are reviewed and an empirical method for determining filter spacing is discussed. Hydrological equations of the reviewed methods are critically analyzed. (Gabriel-USGS)
W70-02674

DELAWARE RIVER BASIN COMMISSION ANNUAL REPORT 1969.

Delaware River Basin Commission, Trenton, N.J.

Delaware River Basin Commission, Trenton, NJ, 08663, 1969. 21 p.

Descriptors: *Water policy, *Interstate, *Institutions, *Water pollution control, Cost sharing, Regulation, Water pollution, Pollution abatement.

Identifiers: *Effluent standards, Abatement schedules, Centralized waste treatment systems.

This is the annual report of the only interstate-federal organization covering the full range of water management in the United States. The economic significance of the report relates mostly to water quality control. The commission first adopted river quality standards similar to those imposed elsewhere. It was then estimated that this required a reduction by two-thirds of the oxygen-consuming wastes entering the estuary. This total was then subdivided into four zones, since it was found that economic efficiency would not be served by similar treatment of all zones. During 1969 an allotment was made to each industrial and municipal treatment plant of its maximum contribution to the total load. This transposes the stream standards, which represent only general objective, to effluent standards, which represent a specific restraint on the individual polluter. Following this, abatement schedules are approved, by which the timing for meeting the target is agreed upon. A number of appeals are still pending, but 74% of the dischargers have already accepted the effluent standards. Progress is also being made towards organizing centralized (or 'regional') waste collection, conveyance and treatment systems, which are expected to provide advantages of economy, efficiency and easier pollution control. The operations of the DRBC are of great significance nationally, since similar actions will have to be taken in many developed regions, but institutions to establish such programs in large river basins are generally lacking. (Whipple-Rutgers)
W70-02694

AN EXAMINATION OF NONTREATMENT PLANT ALTERNATIVES IN WATER POLLUTION CONTROL.

Leonard Ortolano, and Harold A. Thomas, Jr.

Water - 1968, Chemical Engineering Progress Symposium Series, AlChE Vol 64, No 90, p 10-20, (1969).

Descriptors: *Systems Analysis, *Water quality control, *Water pollution treatment, *Water pollution control, Aeration.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

Identifiers: Mathematical programming, Instream aeration, Ocean disposal, Removal bottom deposits.

There are a variety of alternative methods for controlling water quality in rivers and estuaries. Where dissolved oxygen is the water quality parameter under consideration, these alternatives include primary sewage treatment plants, secondary sewage treatment plants, tertiary sewage treatment plants, increase in the reaeration coefficient, control of combined sewer overflows, removal of bottom deposits, and piping of wastes outside the basin for ocean disposal. A series of mathematical programming models are presented to investigate the relative merits of these alternatives in a program to maintain a given dissolved oxygen concentration at minimum cost. The Delaware Estuary is used to present sample computations and results. The models are considered as a useful preliminary tool in answering the following questions. Which alternatives should be employed. When (and where) should they be introduced. At what scale should they be operated. (Whipple-Rutgers)

W70-02695

STUDY OF EQUIPMENT AND METHODS FOR REMOVING OIL FROM HARBOR WATERS, Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.

Paul C. Walkup, Palmer L. Peterson, Lloyd M. Polentz, Eric H. Phinney, and John D. Smith.

Available from the Clearinghouse as AD-696 980, \$3.00 in paper copy, \$0.65 in microfiche. Naval Civil Engineering Laboratory Port Hueneme, California, Final Report CR70.001, Aug 25, 1969. 53 p, 14 tab, 28 fig, 56 ref. US Navy Contract N62399-69-C-0028. NCEL Project YF38.534.003.01.002.

Descriptors: *Evaluation, *Oil wastes, Oily water, Water pollution sources.

Identifiers: *Oil spillage, Naval craft (US), Ports and harbors (Hydrological characteristics), Ports and harbors (Geographical characteristics), Ports and harbors (Physical features), Effectiveness, *Cost effectiveness.

A cost effectiveness analysis was performed for equipment, materials, and techniques for the removal of spilled petroleum products from the surfaces of ports and harbor waters used by U.S. Naval craft. Effectiveness criteria, formulated for presently practiced methods and available equipment and materials, included speed, completeness, ease of operation, effect on marine life, and availability. Parameters for the effectiveness study were based on the petroleum products now in use or planned for future use and a detailed review of the geographic, hydrographic, physical and environmental characteristics of ports used by the U.S. Navy. It was found that the two most cost effective systems for broad application were mechanical recovery of spilled material by surface suction devices supplemented by mechanical containment and the application of chemical dispersants by pier or vessel mounted high pressure spray equipment. Recommendations included: the development of additional technology pertinent to petroleum product spills of concern to Naval installation; additional management planning and preparation for coping with spill incidents; installation of equipment at Naval facilities to protect sensitive areas; and support of innovative development activities for improved equipment and methods for coping with petroleum spills.

W70-02725

SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL, New Mexico State Univ., University Park. For primary bibliographic entry see Field 02G.

W70-02729

CHEMISTRY OF THE OXIDANT, FERRATE, ITS INTERACTION WITH SPECIFIC ORGANICS FOUND IN WASTE WATER, Kentucky Water Resources Inst., Lexington.

Donald H. Williams.

Available from the Clearinghouse as PB-188 800, \$3.00 in paper copy, \$0.65 in microfiche. Research Report No 20, Kentucky Water Resources Institute, Lexington, 1969. 13 p, 6 tab, 7 ref. OWRR Project A-008-Ky.

Descriptors: *Oxidation, *Chemical degradation, Waste treatment, Organic wastes.

Identifiers: *Ferrate.

Techniques for the preparation of potassium ferrate were reviewed and mechanical improvements made which allowed increased yields in shorter times. Relative rates of oxidation of a number of alcohols and other organic compounds were determined in 8M and 0.12 M KOH, and in a solution buffered to pH 8.04 with phosphate. The objective was to determine if the ferrates could be used to oxidize organic pollutants in water. Based on the results of this study, it must be concluded that such a process does not appear to be highly effective for dilute solutions.

W70-02738

EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING, AND PREVENTING POLLUTION, B-166506, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION.

General Accounting Office, Washington, D.C.

Available from the Comptroller General of the US, General Accounting Office, Washington, DC, for \$1.00 per copy. Report to the Congress, General Accounting Office, Washington, DC, 1969. 164 p.

Descriptors: *Pollution abatement, *Water pollution control, *Benefits, Water pollution, Water quality, Systems analysis.

Identifiers: Centralized waste treatment systems.

The General Accounting Office (GAO) has examined into the effectiveness of the construction grant program of the Federal Water Pollution Control Administration (FWPCA), which is directed toward abating, controlling and preventing water pollution. During FY 1957-69, FWPCA awarded grants of about \$1.2 billion for the construction of some 9,400 projects having a total estimated cost of about \$5.4 billion. These projects have contributed to abating water pollution, but less effectively than they might have, since in many cases other major polluters nearby continued to discharge untreated or inadequately treated wastes. The program has been administered by awarding contracts on a readiness-to-proceed basis. Little consideration has been given to the immediate benefits to be received. GAO believes that the present level of Federal funding is inadequate to achieve a significant increase in the effectiveness of the program. Systems analysis techniques and evaluation of benefits are recommended. Planning should be conducted on a river basin basis, or by a single state agency for all of the state. There is also a criticism of the Dept. of Interior's minimum standard of secondary treatment for all effluents. Comments on the findings by the FWPCA are included, and are of interest. (Whipple-Rutgers)

W70-02743

COMBATING POLLUTION CREATED BY OIL SPILLS, VOLUME I: METHODS,

Little (Arthur D.), Inc., Cambridge, Mass.

A. V. Pastuhov, S. S. Gray, and A. E. Wechsler.

Available from the Clearinghouse as AD-696 635, for \$3.00 in paper copy, \$0.65 in microfiche. Washington, DC: US Coast Guard, June 30, 1969. 151 p, 28 tab, 6 fig. Contract DOT-CG-93.374-A.

Descriptors: *Research and development, *Water pollution control, *Oil, *Cost analysis, Abatement.

Absorption, Adsorption, Burning, Biodegradation, Detergents, Dispersion, Disposal, Operations, Equipment, Emulsifiers, Trace elements, Remote sensing.

Identifiers: *Recovery equipment, *Containment equipment, Pumps (Vacuum), Air curtains, Booms, Sinking agents, Skimmers.

Of primary interest to the professional, this study provides information on the state-of-the-art of available methods for combating oil spills, along with their basic technology. It rates the effectiveness of each method on the basis of technical, ecological, and operational considerations and presents qualitative cost information associated with actual oil spill cleanup operations. Discussed are mechanical removal, physical sinking methods, chemical dispersion, physical absorption, combustion, biological degradation. Because of the undeveloped state-of-the-art of the various combatant methods, the indicated costs in the cost analysis are not so much quantitative measures as they are comparative ones. (Koburger-US Coast Guard)

W70-02744

PHOSPHORUS BUDGETS OF LAKES SIDNEY LANIER AND HARTWELL, GEORGIA, Georgia Univ., Athens. Biological Sciences Div.

Donald C. Scott.

Project Termination Report, University of Georgia, Jan 1970. OWRR Project A-011-GA.

Descriptors: *Phosphorus, *Iron, *Organic nutrients, *Ions (Sulfide), Reservoir ecology, Sulfides, Manganese, Filtration, Limnology, Anaerobic conditions.

Identifiers: *Lake Sidney Lanier (Ga), *Lake Hartwell (Ga).

The purpose of the research was to compare the animal cycles of phosphorus, iron, and functionally related elements in two large man-made impoundments, Lakes Sidney Lanier and Hartwell, Georgia. The research was expected to yield information on the effects of organic pollution that would be useful in management of other large impoundments and a base for comparison of future developments at the lakes. An analytical research laboratory was established to provide quantitative data on the various forms of phosphorus, iron, and functionally related elements. Laboratory procedures involving millipore filtration and persulfuric acid were developed to separate phosphorus and iron into its several forms for quantitative analysis by standard techniques. Much effort was expended to develop an improved technique for the quantitative determination of the sulfide ion. Precipitation techniques and sulfide stabilization methods were investigated and the results indicated that these techniques showed promise for accurate analysis when applied to samples in the field, providing stability for subsequent laboratory analysis. Termination of the research prevented further development. (Conway-Georgia Tech)

W70-02752

BUOYANCY AND SINKING CHARACTERISTICS OF FRESHWATER PHYTOPLANKTON,

Rhode Island Univ., Kingston.

Theodore J. Smayda.

Technical Completion Report, Rhode Island Water Resources Center, 1969. 7 p. OWRR Project B-006-RI.

Descriptors: *Flotation, *Sinking, *Phytoplankton, *Diatoms, *Blue-green alga, Copper sulfate.

The sinking rates of selected freshwater phytoplanktons were determined. The species were the diatoms *Asterionella formosa*, *Tabellaria flocculosa*, and the blue-green alga *Aphanizomenon flos-aquae*. The sinking rates of some brackish-coastal water diatoms which have morphological homologues in freshwater were also investigated to examine the influence of morphology on sinking rate. Sinking rates of the freshwater forms used

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Water Quality Control—Group 5G

were found to approximate those (approximately 0.2 to 1 meters day⁻¹) for marine phytoplankters. Increased culture age and colony (Chain) size favored increased sinking rates. Sinking could be heightened by the addition of CuSO₄, formalin and KI. Killing by heat also heightened sinking. The addition of 0.1% butanol and isopropanol also heightened sinking of the diatoms used, but only the butanol treated blue-green alga cells responded thusly. These algae remained viable despite the alcohol treatment. Their heightened sinking rate (and, conversely, therefore one of their suspension aides) appears to relate in toto (or primarily) to a change in total cell density due to osmotic disruptions and/or disturbance of the cell membrane electrotropokinetics which can influence the hydrofuge or hydrophilic properties of the cell. The results with CuCO₄ addition suggest that in addition to control of noxious water blooms through growth cessation by this agent, sinking of certain phytoplankters may also be promoted leading to settling out of the trophogenic zone into the aphotic layers where remineralization occurs.

W70-02754

EVALUATION OF FACTORS AFFECTING STREAM SELF-PURIFICATION,

Washington State Univ., Pullman.

Donald E. Proctor.

Available from the Clearinghouse as PB-188 903, \$3.00 in paper copy, \$0.65 in microfiche. Final Report, Washington State Univ., College of Engineering, Bulletin 316, 1969. 39 p, 11 fig, 5 tab, 4 ref. OWRR Project A-008-WASH.

Descriptors: *Self-purification, *Stream models, *Residence age, *Attached growth, *Tracers, Water quality, Streams.

Four identical parallel-flow models were constructed to simulate certain characteristics of flowing streams in order to evaluate self-purification processes. The models were maintained at nearly constant temperature and housed to prevent photosynthesis. Each model consisted of 28 sequentially connected, rectangular, plastic basins equipped with paddle agitators. The relationships of residence age of water at any point in the model to flow rates was determined both theoretically and empirically. The relationships agreed quite closely. The longitudinal dispersion of a tracer through the models is high but quite predictable using derived equations. The ratio of liquid volume to wetted surface area (i. e. effective stream depth) was very low. This resulted in a predominance of metabolic activity by attached organisms and a high degree of self-purification in the first few basins of any model. Substrate biodegradability, as indicated by k values for BOD exertion, changed significantly and rapidly as flow progressed through the models. Self-purification response to copper sulfate fed as a possible toxicant indicated a retardant effect that persisted beyond the wash-out period for the toxicant.

W70-02758

DESIGN OF A COMBINED SEWER FLUIDIC REGULATOR, THE DEVELOPMENT OF BASIC CONFIGURATIONS AND DESIGN CRITERIA FOR APPLICATIONS OF FLUIDS IN SEWER REGULATORS.

Bowles Engineering Corp., Silver Spring, Md.

For primary bibliographic entry see Field 04A.

W70-02773

IMPOUNDMENT INFLUENCES ON WATER QUALITY,

Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Engineering Section.

James M. Symons, Samuel R. Weibel, and Gordon G. Robeck. Journal American Water Works Association, Vol 57, p 51-75, Jan 1965. 19 fig, 2 tab, 45 ref.

Descriptors: *Water pollution control, *Streamflow, *Water quality, *Impoundments, Water pu-

rification, Simulation, Nitrogen, Water properties, Iron, Manganese, Oxygen requirements.

Identifiers: *Artificial destratification, *Impoundment releases, Simulation tanks, Soil-water contact columns, Impounded water quality.

This paper is concerned with the inadequately studied problem of the quality of impounded water and the practicability of release for stream regulation. Success of this method will require additional research in the systems analysis field, behavior of iron, manganese, nitrogen, phosphorus, and oxygen in impounded environments, influence of physical factors and fertilization, and the effect of impoundment releases on the quality of downstream water. Research now in progress is concerned with small-scale simulation of stratified impoundment and nitrogen transformations. Both thermal and chemical stratification have been accomplished in a 9-foot-high, 500-gal tank. Recorded profile values include temperature, dissolved oxygen, iron, manganese, pH, total hydrolyzable phosphate, and various forms of nitrogen. Nitrogen transformations have been observed in 5-gal glass jars provided with mechanical mixers and sampling siphons. Fortified water supplied vitamins, minerals, amino acids, and ammonium sulfate. The seed was obtained from an activated-sludge plant. Influence of seed variations, concentration of ammonia, and turbulence on dynamics of organic and mineral forms of nitrogen was recorded. A tentative suggestion is made that mechanical aeration may be a more feasible method of stream amelioration than dilution with water carrying 8 parts per million of dissolved oxygen. (Wilde-Wisconsin)

W70-02785

MINES AND MINING.

Pa Stat Ann tit 52, secs 30.51, 30.54, 30.56 (Supp 1969).

Descriptors: *Pennsylvania, *Mining, *Water pollution, *Air pollution, Legislation, Administrative agencies, Administrative decisions, Safety, Mine wastes, Coal mine wastes, Coal mines, Waste dumps, Water pollution sources, Industrial wastes, Mining engineering, Public health, Mine drainage, Dams, Drainage, Ditches, Standards, Water quality.

The operation of a coal refuse disposal pile is prohibited when it fails to comply with the established rules and regulations or quality standards adopted to avoid air or water pollution. Any operator of a coal refuse disposal pile may be ordered to build drainage ditches, trenches and/or gullies, to build impervious dams, to alter locations, to engage in spreading soil, or to use inert sealing materials if some or all of the foregoing are necessary to prevent or correct conditions of air or water pollution. Mine inspectors directed by the Department of Mines and Mineral Industries have the right to inspect and examine any coal refuse disposal area. Conditions which constitute a danger to any person, property, or highways or which fail to meet standards adopted to avoid air or water pollution may be ordered corrected. If there is a failure to comply, the Sanitary Water Board or the Air Pollution Commission may take appropriate actions under existing laws. (Schram-Florida)

W70-02820

SCHUYLKILL RIVER POLLUTION.

Pa Stat Ann tit 32, secs 751.1-751.9 (1967).

Descriptors: *Pennsylvania, *Water pollution control, *Desilting, *Supervisory control (Powers), Water pollution, Administrative agencies, Waste water (Pollution), Water pollution treatment, Abatement, Reservoirs, Levees, Dams, Construction, Dredging, Alteration of flow, Relocation, Area redevelopment, Legislation, Legal aspects, Silting, Silts, Condemnation, Regulation, Highway relocation.

The Water and Power Resources Board of the Department of Forests and Waters is hereby designated to carry into effect the project for the construction of desilting basins in the headwaters of the Schuylkill River and its tributaries to prevent the future silting and pollution of that river. The Board is authorized to: (1) clean out, widen, alter, dredge, deepen or change the course, current, or channel of the Schuylkill River or any of the tributaries; (2) fill up any abandoned canal or watercourse; (3) construct levees, dikes, walls, revetments, dams, reservoirs, and other improvements; and (4) prohibit any dredging operation deemed inimical to the purposes of the act. The Board may sell or lease materials or fill derived from dredging. The Board may enter into agreements with persons or municipalities for relocation of utility or telephone lines, highways, or other facilities. The Board may acquire easements, rights-of-way, or freeholds in carrying out this act, and may use condemnation proceedings under certain circumstances. The Board may obtain cooperation from federal, state, and local agencies. (Kelly-Florida)

W70-02828

CLEAN STREAMS LAW.

Pa Stat Ann tit 35, secs 691.3, 691.4 (1964), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Water pollution, *Water purification, *Streams, Water pollution effects, Water pollution treatment, Pollution abatement, Water pollution control, Wastes, Public health, Legislation, Water allocation (Policy), Legal aspects, Pollutants, Impaired water quality, State jurisdiction.

The discharge of sewage or industrial wastes or other deleterious substances which are injurious to public health or to animal or aquatic life is hereby declared an unnatural use of such waters and a public nuisance. The legislature has found it a matter of public policy not only to prevent further pollution of the state's waters, but also to reclaim and restore to an unpolluted condition every stream in the state. The Clean Streams Law should be interpreted to fulfill both objectives. (Kelly-Florida)

W70-02832

SEWAGE POLLUTION.

Pa Stat Ann tit 35, secs 691.201-691.210 (1964).

Descriptors: *Pennsylvania, *Water pollution control, *Sewage disposal, *Cities, Permits, Local governments, Public health, Legal aspects, Legislation, Financing, Sewage treatment, Administrative agencies, Supervisory control (Power), Treatment facilities, Pollution abatement, Regulation, Construction, Water quality control.

Identifiers: *Sewer systems, Penalties (Civil).

No person or municipality shall discharge sewage into any waters of the Commonwealth when such discharge is or may become injurious to the public health, animal, or aquatic life. The Sanitary Water Board shall order the discontinuance of existing discharges of sewage by notice in writing, and failure to obey such order within the time provided by the Board is declared a nuisance, punishable by fine and/or imprisonment. Municipalities with a sewer system which discharges sewage into the waters of the Commonwealth shall file a report of such sewer system upon written request of the Board. Municipalities may apply to the Board for a permit to discharge sewage into the waters of the Commonwealth. A permit may be granted if the Board finds such discharge is necessary and not injurious to the public health. All plans and relevant data for the construction of new sewer systems or the extension of existing sewer systems must be submitted to and approved by the Board. Municipalities may issue bonds to cover the costs of acquiring, constructing, or altering such sewer systems or sewage treatment plants as are required by the Board. (Sisserson-Florida)

W70-02833

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

FISH CONSERVATION.

Wis Stat Ann secs 29.283, 29.286, 29.288, 29.29 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Fish conservation, *Water pollution effects, *Fishkill, Legislation, Legal aspects, Conservation, Structures, Regulation, Nets, Administrative agencies, Ice fishing, Water pollution, Solid wastes, Explosives, Poisons, Pesticide toxicity.

Identifiers: Fish traps, Penalties (Civil), Penalties (Criminal).

The Conservation Commission will establish regulations governing the use of buildings, vehicles, tents, fish shanties, and similar shelters for fishing through the ice in the waters of the state. No person shall have in his possession any net or fish trap capable of taking, catching, or killing fish in specified counties. Whoever deposits, places, or throws into any waters of the state, or leaves on the ice thereof, any solid waste material will be subject to criminal penalties. The use and possession of explosive or stupefying substances in the waters of the state is prohibited, with specified exceptions. Violation of this provision will result in criminal penalties. No person will use, set, lay, or prepare in the waters of the state any substance deleterious to fish life other than such substances deposited in accordance with plans approved by the Committee on Water Pollution. No person will disperse any toxic insecticide in forest or non-crop areas in amounts sufficient to be of possible danger to the health of persons or wildlife. (Keith-Florida)

W70-02836

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

OPERATIONS RESEARCH STUDY OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT OF THE TUCSON BASIN,

Arizona Water Resources Research Center, Tucson.

Chester C. Kisiel, and Lucien Duckstein.

Available from the Clearinghouse as PB-188 797, \$3.00 in paper copy, \$0.65 in microfiche. Arizona Water Resources Research Center, Project Completion Report, Dec 1969. 27 p, 10 ref. OWRR Project A-010-ARIZ.

Descriptors: *Income analysis, *Operations research, *Pricing, *Water allocation, Computer models, Information retrieval, Model studies, Monte Carlo method, Numerical analysis, Parametric hydrology, Simulated rainfall, Synthetic hydrology, Time series analysis, Economic efficiency, Elasticity of demand, Economic prediction, Water rates, Water requirements, Water demand, Future planning, Water quality controls, Waste dilution, Oxygen sag, Natural recharge, Groundwater mining, Thunderstorms, Ephemeral streams. Identifiers: *Econometric models, Arizona, Systems hydrology, Simulation of aquifers, Streamflow, and thunderstorm sequences, Water quality management.

The research objective was to undertake a systematic application of tools of operations research to problems of water resource management in metropolitan Tucson, Arizona. Concepts of general systems theory served as a basis for structuring the research and reviewing literature and were explicitly applied in the formulation of a simulation model for water quality management. Physical models were developed for the following processes: natural recharge from an ephemeral stream, point thunderstorm precipitation, and groundwater movement for the Tucson aquifer. Constraints on data availability were revealed by the econometric model of residential water consumption as a function of median family income. The major result of the study was development of a pricing model for optimal allocation of Tucson's groundwater.

Colorado River water, reclaimed waste water and Avra Valley groundwater to municipal, industrial, and agricultural use. The objective function was formulated to maximize net revenues to a central water resource agency (presently not in existence) in the face of availability, requirements and social constraints. Actual data was used to obtain opportunity costs associated with mining or conserving Tucson's groundwater. A final result is an economic calculus model to study the influence of water price structure on collective utility of water.

W70-02680

STOCHASTIC BASIS FOR COMPREHENSIVE RIVER BASIN PLANNING: PHASE I,

Union Coll., Schenectady, N.Y. Water Resources Research Group.

Fred G. Haag, Keith W. Bedford, Joseph W. Fischetti, and James D. Lloyd.

Available from the Clearinghouse as PB-188 798, \$3.00 in paper copy, \$0.65 in microfiche. Report, Water Resources Research Group, Union College, 1969. 49 p. OWRR Project C-1318.

Descriptors: *Mathematical models, *Systems engineering, Computer models, Monte Carlo methods, Optimization.

Results are given from Phase I of a study of the application of stochastic systems analysis to water resources problems. An extensive digital computer program was written to simulate the dissolved oxygen-biochemical demand dynamics in a river basin. The unsteady hydraulic equations were included in the model. Preliminary results indicate that the computer times required for simulation of an entire river basin will be impractical (on a GE415 computer). Migration of salinity in the Hudson River estuary was simulated on a digital computer when the calculated results were compared with U.S. Geological Survey data, the agreement was encouraging. A digital computer program was written to calculate the statistical parameters needed for a linear regression synthetic stream flow generator. Recommendations are given for Phase II.

W70-02681

AN EXAMINATION OF NONTREATMENT PLANT ALTERNATIVES IN WATER POLLUTION CONTROL

For primary bibliographic entry see Field 05G.

W70-02695

EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING, AND PREVENTING POLLUTION, B-166506, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION.

General Accounting Office, Washington, D.C.

For primary bibliographic entry see Field 05G.

W70-02743

6B. Evaluation Process

THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA,

Nebraska Univ., Lincoln, Dept. of Economics.

For primary bibliographic entry see Field 03F.

W70-02479

A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967,

Institute for Land and Water Management Research, Wageningen (Netherlands).

C. Van den Berg, W. C. Visser, J. Wesseling, J. F. Bierhuizen, and G. P. Wind.

Inst Voor Cultuurtechniek en Waterhuishouding Tech Bull No 60, 1968. 91 p, 45 fig, 7 tab.

Descriptors: *Water resources development, *Research and development, *Drainage, *Irrigation, *Land management, Water management (Applied), Irrigation water, Groundwater, Surface waters, Model studies, Mathematical models, Systems analysis, Hydrology, Hydraulics.

Identifiers: *Netherlands, *Water resources research.

Water and land management research in the Netherlands between 1957 and 1967 is summarized. Topics of study include hydrological model studies, research techniques, general hydrology of the Netherlands, groundwater flow, land drainage, soil water, polders, irrigation, soil improvement, and rural development. Hydrological research in the Netherlands has a tendency to include more complex investigations and to integrate research of various disciplines to solve the problems of providing one of Europe's most densely populated regions with a high standard of living. (Knapp-USGS)

W70-02495

GREAT LAKES BASIN COMPACT.

Pa Stat Ann tit 32, secs 817.1-817.6 (1967)

Descriptors: *Pennsylvania, *Great Lakes region, *Interstate commissions, Water resources development, Interstate compacts, Great Lakes, Navigation, Wildlife, Fish, Soil erosion, Soil conservation, Diversion, Water levels, Water policy, St. Lawrence River, Fishing, Natural resources, Regulation, Legal aspects, Administrative agencies, Water pollution.

The Great Lakes River Basin Compact is designed to promote the development and conservation of the water resources of the Great Lakes Basin. The Great Lakes Commission, as created under the compact, will exercise jurisdiction over so much of the following bodies of water as is included within the signatory states: Lakes Erie, Huron, Michigan, Ontario, St. Clair, and Superior; the St. Lawrence River; and all rivers, ponds, lakes, and other watercourses connecting with the St. Lawrence. The composition of the Commission is hereby established. The signatory states agree to consider the Commission's recommendations with respect to lake levels, pollution, navigation, fishing and wildlife resources, soil erosion, and diversion of waters from and into the basin. Any state may withdraw from the compact after six months notice. (Kelly-Florida)

W70-02540

BRANDYWINE RIVER VALLEY COMPACT.

Pa Stat Ann tit 32, sec 818 (1967)

Descriptors: *Pennsylvania, *Interstate compacts, *Water supply, *Water resources development, Water conservation, Flood control, Dams, Reservoirs, Construction, Dam construction, Rivers, Recreation, Parks, Financing, Flow augmentation, Legislation, Legal aspects, State governments, Administrative agencies, Operation and maintenance, Delaware, United States, On-site investigations. Identifiers: Brandywine River.

The Governor is authorized to enter into a compact on behalf of the state for the purpose of joint and cooperative action to promote the orderly development of water resources in the Brandywine Creek Valley for water supply, quality improvement, flood prevention and control, watershed protection, conservation, and recreation. The Department of Forests and Waters is authorized to construct and operate dams and reservoirs on the Brandywine Creek and its tributaries, to maintain state parks at the dam sites, and to cooperate with the state of Delaware in financing dams and low flow augmentation of the creek at the state boundary line. The Department is also empowered to cooperate with and receive funds from the United States government, to supply water to certain areas, and to permit on-site inspections of dam and

reservoir operation by the State of Delaware and local interests in Pennsylvania. (Kelly-Florida)
W70-02541

INLAND WATERWAY TRANSPORTATION, STUDIES IN PUBLIC AND PRIVATE MANAGEMENT AND INVESTMENT DECISIONS,
Resources for the Future, Inc., Washington, D.C.
Charles W. Howe, Joseph L. Carroll, Arthur P. Hurter, Wm. J. Leininger, and Steven G. Ramsey,
Resources for the Future, Inc., Johns Hopkins Press, Baltimore, Md, 1969. 144 p.

Descriptors: *Inland waterways, *Evaluation, *Economic efficiency, Transportation, Economics, Technology.
Identifiers: Optimum level of investment, Optimum level of traffic.

Economic aspects of inland waterways transportation have been relatively little explored. This study summarizes information available and outlines a theoretical economic efficiency model for waterway investment and management. Aspects covered include technology and production functions for the two, returns to scale for the firm, determination of equipment requirements for the barge-line, traffic flow and congestion simulation, and the demand for inland waterway transportation. This demand model can be used to analyze effects of changes in specific demands for barge transportation. The results of this study should facilitate further research into major problems of government policy related to inland transportation. (Whipple-Rutgers)
W70-02700

A COMPREHENSIVE STUDY OF THE USE TAX AS A MEANS OF ALLOCATION OF WATER RESOURCES IN A CONJUNCTIVE USE SYSTEM,
California Univ., Davis, Dept. of Political Sciences.
For primary bibliographic entry see Field 06C.
W70-02757

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

OPERATIONS RESEARCH STUDY OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT OF THE TUCSON BASIN,
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 06A.
W70-02680

A COMPREHENSIVE STUDY OF THE USE TAX AS A MEANS OF ALLOCATION OF WATER RESOURCES IN A CONJUNCTIVE USE SYSTEM,
California Univ., Davis, Dept. of Political Sciences.
Louis F. Weschler.
Available from the Clearinghouse as PB-188 917, \$3.00 in paper copy, \$0.65 in microfiche. Technical Completion Report WRC 180, California Water Resources Center, Nov 1969. 3 p. OWRR Project A-025-CAL.

Descriptors: *Use rates, Water allocation, Resource allocation, Costs, *Conjunctive use, *Cost comparisons, *Cost allocation.

An important problem in areas which have both ground and surface water supplies is management of the conjunctive system so each supply is devoted to its best use. In California, some local water districts have been authorized to levy a production or use tax on groundwater production; it could serve as a means of rational allocation of water resources among users and uses. None of the four water districts included in this project applied the use tax in a manner to secure optimal use of alternate water sources. The main restraints were found to be opposition to the use by important economic in-

terests, legal constraints contained in California law restricting variations in taxes, and misunderstanding of the potential of the use tax by public officials of the districts. A model of idealized water supply, demand, cost, use and allocation was established for each district. Three projections, 1950-80, were established to compare with this model: actual patterns, trends based upon actual patterns, and hypothetical trends excluding use tax operations. It was found that in spite of wide variations in actual practice and suboptimal performance by all districts that the use tax is useful. In all four districts the relative distribution of ground and surface water to different uses was improved by the operations of the use tax. Thus, the tax does encourage rational planning and use.
W70-02757

6D. Water Demand

WATER FOR INDUSTRIAL DEVELOPMENT IN COVINGTON, JEFFERSON DAVIS, LAMAR, LAWRENCE, MARION, AND WALTHALL COUNTIES, MISSISSIPPI,
Geological Survey, Jackson, Miss. Water Resources Div.
For primary bibliographic entry see Field 03E.
W70-02478

THE LAW OF SURFACE WATER IN MISSOURI,
For primary bibliographic entry see Field 04A.
W70-02577

6E. Water Law and Institutions

LEGAL AND ECONOMIC ASPECTS OF SALT-WATER ENCROACHMENT INTO COASTAL AQUIFERS,
Bookman and Edmonston, Glendale, Calif.
For primary bibliographic entry see Field 02I.
W70-02492

REGULATION OF HUNTING AND FISHING IN INTERSTATE WATERS.

Wis Stat Ann secs 29.085, 29.09 (1) (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Regulation, *Fishing, *Permits, Hunting, Trapping, Conservation, Wildlife conservation, Administrative agencies, Legislation, Legal aspects.
Identifiers: *Interstate waters, *Inland waters.

The Conservation Commission is authorized to regulate hunting and fishing on all interstate boundary waters and specified outlying waters. Except as expressly provided, no person will: (1) hunt any wild animal; (2) trap any game; or (3) take, catch, or kill fish or fish in inland waters of the state without a license. (Keith-Florida)
W70-02502

INTERSTATE COMMERCE - NAVIGABLE RIVERS - INDUSTRIAL WASTE CLOGGING CHANNEL HELD NOT UNLAWFUL OBSTRUCTION - UNITED STATES V REPUBLIC STEEL CORP (7th CIR 1959).
For primary bibliographic entry see Field 05G.
W70-02512

REMARKS BY CONGRESSMAN WILLIAM C. CRAMER BEFORE THE 56TH ANNUAL CONVENTION, NATIONAL RIVERS AND HARBOURS CONGRESS.
For primary bibliographic entry see Field 05G.
W70-02513

PREVENTION OF POLLUTION.
For primary bibliographic entry see Field 05G.

W70-02514

DRAINAGE RIGHTS.

For primary bibliographic entry see Field 04A.
W70-02515

CLAIMS AGAINST AND CONTRACTS WITH OTHER DISTRICTS AND MUNICIPAL CORPORATIONS EXERCISING DRAINAGE POWERS.

For primary bibliographic entry see Field 04A.
W70-02516

BAER V BD OF COUNTY COMM'RS OF WASHINGTON COUNTY.

For primary bibliographic entry see Field 04C.
W70-02517

WATER CONSERVATION AND RECLAMATION FUND.

For primary bibliographic entry see Field 05G.
W70-02518

UNLAWFUL ENTRY UPON RESERVOIRS, PONDS, AND DAMS.

Pa Stat Ann tit 35, sec 2106 (1964).

Descriptors: *Pennsylvania, *Dams, *Reservoirs, *Reservoir operation, Standing waters, Water resources, Water supply, Ponds, Reservoir storage, Structures, Electric power production, Impounded waters, Legislation, Legal aspects, Reservoir sites, Administrative agencies, Supervisory control (Powers), Regulation.
Identifiers: Trepass.

The Water and Power Resources Board of the Department of Forests and Waters may post signs prohibiting entry upon any dam, breast, ramp, power house or other structure located on a navigable public stream or river, or upon the pond or reservoir created by such structure. The structures may be owned by private individuals, corporations, or political subdivisions of the state. The primary purpose of such structures must be for the generation, manufacture, transportation, and distribution of electricity, or for the storage of water for domestic, industrial, or water power purposes. Anyone entering upon these properties without permission from the Board during a period of national emergency or war may be tried in a summary proceeding and sentenced to fine or imprisonment upon conviction. (Kelly-Florida)
W70-02519

PETITION TO COURT FOR DRAINAGE AND APPOINTMENT OF COMMISSIONERS.

For primary bibliographic entry see Field 04A.
W70-02520

SOIL CONSERVATION POLICY.

For primary bibliographic entry see Field 04D.
W70-02521

POLLUTION OF DRINKING WATER.

For primary bibliographic entry see Field 05F.
W70-02522

STREAM BOUNDARIES.

Pa Stat Ann tit 53, sec 65301 (1957).

Descriptors: *Pennsylvania, *Boundaries (Property), *Navigable rivers, *Cities, Local governments, Navigable waters, Boundary disputes, Legal aspects, Rivers, Streams, Water rights, Legislation.

Whenever two townships are both bounded by the nearest margin of a navigable stream, the middle of such navigable stream shall be the boundary between the two townships. (Smith-Florida)

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

W70-02523

CITIES' POWER OVER WATERCOURSES.

For primary bibliographic entry see Field 04A.

W70-02524

CITIES OF THE SECOND CLASS: POWERS RELATING TO LEVEES, FERRIES, WHARVES, CHANNELS, PIERS, AND INFLUENT PIPES.

For primary bibliographic entry see Field 04A.

W70-02525

INTERFERENCE WITH DRAINAGE FACILITIES.

For primary bibliographic entry see Field 04A.

W70-02526

LEASING STATE FORESTS FOR WATER POWER.

Pa Stat Ann tit 32, secs 136-137 (1967).

Descriptors: *Pennsylvania, *Forests, *Leases, *Water resources development, Contracts, State governments, Forest management, Natural resources, Land resources, Water resources, Resource development, Administration, Administrative agencies, Steam, Electric power, Thermal power, Hydroelectric plants, Electric power production, Public utilities, Reservoirs, Canals, Obstruction to flow, Pipelines, Conduits, Condensation.

The Department of Forestry, with the approval of the Governor and Attorney General, is authorized to lease for not more than fifty years any portions of this state's forests for the following purposes: dams and other water obstructions, reservoirs, canals, pipe lines, and other water conduits for the development of water power by steam condensation or otherwise. Every such lease shall contain such terms as are necessary to protect the present and future interests of this state and its people including an option in the Commonwealth to renew the lease or to take over such project works upon payment of the actual net investment in such work. (Smith-Florida)

W70-02527

REGISTRATION AND ADOPTION OF 'MARK' AS IDENTIFICATION OF LUMBER UPON THE ALLEGHENY RIVER.

Pa Stat Ann tit 32, sec 575 (1967).

Descriptors: *Pennsylvania, *Lumbering, *Regulation, Legislation, Flotsam, State governments, Administration, Tributaries, Local governments, Legal aspects, Management, Permits, Rivers.

Any person engaged in lumbering upon the Allegheny River or its tributaries in McKean County must adopt one mark of designation. This mark is to be placed on all spars, logs, masts, or other lumber intended to be floated in the River. Other marks may be used but only in addition to the mark of designation. It is the duty of the prothonotary of the court to file and record such marks as are adopted. The certificate of filing is *prima facie* evidence of the right of the person filing to use such mark. The right to the use of any mark shall depend on priority of registration. The purpose of this act is that no two persons or companies shall use the same mark. (Barnett-Florida)

W70-02528

APPROPRIATION AND CONDEMNATION OF LANDS AND WATERS TO ENABLE COMPLETION OF AUTHORIZED PROJECTS.

Pa Stat Ann tit 32, sec 623 (1967).

Descriptors: *Pennsylvania, *State governments, *Public utilities, Legislation, Regulation, Administration, Permits, Management, Electric power production, Water supply, Legal aspects, Condemnation, Appropriation, Administrative agencies.

Any public service company holding a limited power permit or a limited water supply permit, granted on behalf of a project for use in public service, shall have the right and power to condemn and appropriate any lands, waters, and other property. Such appropriation is subject to a finding of the Commission after due notice and hearing, that the action is necessary for the maintenance of the project for which the permit was issued. Also, such appropriation must not be incompatible with the public interests of the region in the vicinity of the project. The Commission has been renamed the Water and Power Resources Board, 71 Pa Stat Sec 12 (1967). (Barnett-Florida)

W70-02529

UNDERGROUND WATER DEVELOPMENT.

Pa Stat Ann tit 32, secs 645.1, 645.4-645.13 (1967).

Descriptors: *Pennsylvania, *Water wells, *Well permits, *Water conservation, Wells, Drilling, Groundwater, Water sources, Water supply, Permits, Well regulations, Regulation, Administration, Conservation, Water resources development, Resources, Natural resources, Administrative agencies.

Whereas the renewable natural resource of underground water must be developed in an orderly and reasonable manner, it is the policy of this state to encourage such development. A license shall be required to drill water wells, except for farming or residential uses. The Department of Internal Affairs may require any abandoned well to be sealed. A described application shall be made before any license is issued. A license shall be required for any drilling rig. The Department is empowered to revoke or suspend licenses for fraud in obtaining the same or failure to file reports or maintain records required by this act. Each licensee is required to keep a record of each well setting forth certain information. Failure to comply with these provisions is punishable by fine or imprisonment. The Department is authorized to effectuate the provisions of this act and to adopt rules and regulations. (Smith-Florida)

W70-02530

FLOOD CONTROL.

For primary bibliographic entry see Field 04A.

W70-02531

REFORESTATION SURVEY.

For primary bibliographic entry see Field 04D.

W70-02532

UNITED STATES PROJECTS.

Pa Stat Ann tit 32, secs 678.1-678.2 (1967).

Descriptors: *Pennsylvania, *Flood control, *Flood protection, *Flooding, Flood damage, Federal government, State governments, Local governments, Highways, Bridges, Check structures, Administrative agencies, Construction, Legislation, Legal aspects, Channel improvement, Dredging, United States.

The Commonwealth and its political subdivisions may grant easements to the United States and may enter into agreements with the federal government or its agencies concerning certain aspects of flood control. In any case, where the United States has commenced or finished any work on or construction of a retarding dam, channel improvement, or other flood control project in relation to any river, stream, or creek in the state, the authorized federal representatives may secure easements in highways or bridges when such action is necessary for the project's successful operation and for the safety of life and property. Rights which may be granted include: the right to flood any highways, bridges, or viaducts for temporary periods; the right to enter said highways and lands bordering them to widen rivers or streams or to erect structures upon such lands; and the right to relocate roads, bridges, viaducts, and other public works. (Kelly-Florida)

W70-02533

OBSTRUCTIONS NOT TO BE MADE OR ALTERED WITHOUT CONSENT.

For primary bibliographic entry see Field 04A.

W70-02534

POTOMAC RIVER POLLUTION.

For primary bibliographic entry see Field 05G.

W70-02535

PYMATUNING SWAMP DAM.

For primary bibliographic entry see Field 04A.

W70-02536

LOCATION AND IMPROVEMENT OF RIVERS AND STREAMS.

For primary bibliographic entry see Field 04A.

W70-02537

POLLUTION OF WATERS.

For primary bibliographic entry see Field 05G.

W70-02538

OHIO RIVER VALLEY WATER SANITATION COMPACT.

For primary bibliographic entry see Field 05G.

W70-02539

GREAT LAKES BASIN COMPACT.

For primary bibliographic entry see Field 06B.

W70-02540

BRANDYWINE RIVER VALLEY COMPACT.

For primary bibliographic entry see Field 06B.

W70-02541

PENNSYLVANIA FISHING REGULATIONS APPLYING TO INLAND WATERS AND BOUNDARY LAKES.

Pa Stat Ann tit 30, secs 10-100 (1958), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Fishing, *Fishing gear, *Fish management, Fish, Regulation, Administrative agencies, Legislation, State governments, Lakes, Inland waterways, Farm ponds, Bait fishing, Commercial fishing, Fly fishing, Sport fishing, Baits, Fish conservation, Sport fish, Nets, Permits, Fish harvest, Legal aspects, Fish types, Boats, Identifiers: Sturgeon.

Pennsylvania fishing regulations pertaining to inland waters include provisions concerning: (1) definitions of game fish, bait fish, fish bait, and regulated fishing lake; (2) closed seasons; (3) legal sizes; (4) creel limits on fish and fish bait; (5) net permits; (6) devices to catch game fish, bait fish and fish bait; (7) fishing in farm fish ponds; (8) licensing by the Pennsylvania Fish Commission and the necessity for licenses; and (9) penalties. Fishing regulations pertaining to boundary lakes include provisions concerning: (1) definitions of boundary lake, bay, peninsular waters, game fish, fish bait, bait fish, and food fish; (2) fishing devices; (3) creel limits; (4) closed seasons; (5) fish not to be used for fertilizers; (6) sturgeon; (7) rules, regulations, and powers of the Pennsylvania Fish Commission; (8) boat and net licenses; (9) the securing of spawn; (10) licenses to non-residents; (11) meshes of nets, licensing and use thereof; (12) legal size and weight of fish and fillets; (13) minnow nets; and (14) penalties. (Marsee-Florida)

W70-02542

POLLUTION: TRESPASS ON STATE HATCHERIES.

For primary bibliographic entry see Field 05G.

W70-02543

Water Law and Institutions—Group 6E

MISCELLANEOUS PROVISIONS (RELATING TO WATER).

For primary bibliographic entry see Field 05G.
W70-02544

DISCHARGE OF SEWAGE ON OR WITHIN LIMITS OF HIGHWAY.

Pa Stat Ann tit 36, secs 2621-2623 (1961).

Descriptors: *Pennsylvania, *Sewage, *Drainage, *Outlets, Legal aspects, Surface drainage, Highways, Sewage disposal, Discharge (Water), Legislation.

Identifiers: *Penalties (Criminal), Public nuisances.

It is unlawful for any person, association, corporation, or partnership, to discharge sewage or drainage, with the exception of surface drainage, on or within the legal limits of any public highway. It is unlawful to place a sewer outlet within the limits of a public highway or to so locate it that the discharge therefrom enters a public highway. Criminal penalties are provided for violation of either of the foregoing provisions. (Keith-Florida)
W70-02545

DELAWARE RIVER BRIDGES.

For primary bibliographic entry see Field 04A.
W70-02546

DELAWARE RIVER JOINT TOLL BRIDGE COMMISSION.

For primary bibliographic entry see Field 04A.
W70-02547

INDUSTRIAL WASTES.

Pa Stat Ann tit 35, secs 691.301-691.310 (1964), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Industrial wastes, *Water quality control, *Water pollution control, Administrative agencies, Legal aspects, Legislation, Acid mine water, Waste water treatment, Treatment facilities, Regulation, Public health, Surveys, Investigations, Waste treatment, Discharge (Water), Water pollution sources, Water pollution treatment.
Identifiers: Penalties (Civil).

It is unlawful to discharge industrial wastes into any waters of the Commonwealth unless permission has been given by the Sanitary Water Board. Persons who are discharging industrial wastes into such waters on the effective date of this act shall file with the Board a report including the kind, characteristics, and rate of flow of such discharge. The Board may order such persons to discontinue discharges injurious to the public health or to animal or aquatic life. 'Clean waters' are defined as waters which are, at the effective date of this act, free from any discharge of industrial waste; the Board shall never permit discharge of industrial wastes into such waters unless the wastes have been completely treated. No person shall open an establishment after the passage of this act which will discharge industrial wastes into the waters of the Commonwealth without providing adequate treatment works for the treatment of such wastes. Plans for the treatment works must be submitted to and approved by the Board prior to construction of the works. Violations of these provisions are misdemeanors, punishable by fine and/or imprisonment. (Sisserson-Florida)
W70-02548

PETTY POLLUTION.

For primary bibliographic entry see Field 05G.
W70-02549

DOMESTIC WATER SUPPLIES.

For primary bibliographic entry see Field 05F.
W70-02550

WHARVES, DOCKS, HARBORS.

Pa Stat Ann tit 55, secs 301-302, 311-314, 322 (1964).

Descriptors: *Pennsylvania, *Docks, *Harbors, *Eminent domain, Legislation, Easements, Damages, Compensation, Cost repayment, Condemnation value, Cities, Public benefits, Navigable rivers, Delaware River, Administrative agencies, Administrative decisions, Bulkheads, Piers, Jurisdiction, Legal aspects, Water law.
Identifiers: Warfage, Dockage.

When the owners of wharves, docks, or landings adjoining the Delaware River, not in first class cities, disagree as to the proper apportionment of the wharfage or dockage payable to them, the Board of Commissioners of Navigation shall determine the relative proportions. This shall be done in accordance with the established customs and usages of the port involved, or if there are no such customs, according to justice and equity. Any person may appeal from such a decision to the county court of common pleas. Public landings on any navigable river which have become unnecessary may be taken by eminent domain for public purposes by the city in which they are located. The damages for the taking or injury of any property for use as a public sharp, pier, or bulkhead include full compensation for the value of said property taken and compensation for any damages to the plant. No structure erected pursuant to the provisions of this act may interfere with the general public use of wharves for river commerce. (Schram-Florida)
W70-02569

THE LAW OF SURFACE WATER IN MISSOURI.

For primary bibliographic entry see Field 04A.
W70-02577

DEPARTMENT OF NATURAL RESOURCES.

R I Gen Laws Ann 42-17.1-1 thru 42-17.1-4 (1967).

Descriptors: *Rhode Island, *Natural resources, *State governments, *Administration, Resources, Land resources, Conservation, Forests, Land, Parks, Recreation, Water resources, Wildlife, Water resources development, Resource development, Governments, Legislation, Planning, Regulation, Public utilities, Agriculture, Harbors, Rivers, Development, Fishing, Marshes, Coordination, Supervisory control (Power).

The Department of Natural Resources is established with power and duty to: (1) supervise and control the protection, development, planning, and utilization of the natural resources of the state; (2) exercise all functions, powers, and duties heretofore vested in the Department of Agriculture and Conservation, the Division of Parks and Recreation of the Department of Public Works, or in the Division of Harbors and Rivers of the Department of Public Works; (3) cooperate with the Department of Health in the enforcement of water pollution laws, with the Development Council in its planning and promotional functions, and with conservation commissions of cities and towns. The Department is divided as follows: (1) the Park and Recreation Division with power to establish, operate, and maintain parks and recreation areas; (2) the Conservation Division with the duty to operate, maintain, and preserve forests, natural areas, marsh lands, wildlife areas, hunting and fishing areas; (3) the Agriculture Division, Harbors and Rivers Division, and Planning and Development Division to replace the departments of the same names; (4) the Division of Enforcement which enforces the laws and cooperates with other enforcement agencies. (Smith-Florida)
W70-02584

CONSTRUCTING BRIDGES TO ELIMINATE GRADE CROSSINGS.

Pa Stat Ann tit 15, sec 4112, 4113 (1967).

Descriptors: *Pennsylvania, *Bridges, *Grading, *Highways, Highway relocation, Roads, Civil engineering, Graded, Road construction, Railroads, Bridge construction, Rivers, Streams, Legislation, Legal aspects, Cost allocation, Construction costs, Separable cost allocation.

In order to eliminate grade crossings the Public Service Commission may order that a viaduct or bridge be constructed over, above, and across railroad tracks, rivers, and streams, or that the location thereof be changed to a new place. When a public street or highway is involved, the Public Service Commission may direct that a certain portion of the costs be paid by the Commonwealth. Costs shall be apportioned according to law. (Smith-Florida)
W70-02585

MILL DAMS.

Pa Stat Ann tit 55, secs 291 thru 293 (1964).

Descriptors: *Pennsylvania, *Mill dams, *Mills, *Dams, Legislation, Navigable streams, Dam construction, Damsites, Fish barriers, Fish passages, Boats, Navigation, Sites, Legal aspects, Fish conservation, Fish, Water works, Highways, Roads, Riparian rights.
Identifiers: *Obstruction to navigation, Penalties (Criminal), Penalties (Civil).

Owners of lands adjoining navigable streams may erect dams for mills or other waterworks and lead off so much of the waters of such streams as may be necessary for this purpose. However, such structures may not obstruct or impede the navigation of such stream, prevent the passage of fish, or infringe or injure the rights and privileges of other adjacent landowners. Violators of this chapter may be fined not more than one hundred dollars and may also be made to pay such damages to the person complaining as shall be found by jury. The court must also order every such obstruction removed to comply with the limitations of this act. If the owner of any boat or other vessel suffers damage or is delayed in his passage on any navigable stream by any dams as aforesaid, he may recover such damages from the owner of such dam. (Schram-Florida)
W70-02586

FISH AND GAME LAWS - GENERAL PROVISIONS.

R I Gen Laws Ann secs 20-1-7, 20-1-8, 20-1-10, 20-1-12, 20-1-14, 20-1-17 (1968).

Descriptors: *Rhode Island, *Wildlife conservation, *Wildlife management, *Regulation, Wildlife, Natural resources, Resource development, Fish conservation, Preservation, Hunting, Fishing, Game birds, Waterfowl, Fisheries, Legislation, Massachusetts, Lakes, Permits, Oysters, Shellfish, Commercial fish, Administrative agencies.

The Director of Natural Resources may make rules and regulations governing fishing in Wallum Lake, and he may confer with Massachusetts officials concerning fishing by Massachusetts residents in said lake. The Director is authorized to fix season and bag limits on fresh-water fish. He may appoint and delegate powers to conservation officers for the prosecution of laws relating to fisheries, shellfisheries, wild birds and wild animals. The Director and conservation officers are empowered to: (1) enforce all fish and game laws; (2) execute warrants and issue subpoenas for violations of rules and regulations; (3) take possession of any fish or game taken in violation of this state's laws; and (4) seize all fishing or hunting equipment or licenses used to violate state law. The Director may appoint oyster guards to protect leased oyster grounds and may make all regulations necessary for the enforcement of state shellfish laws. (Smith-Florida)
W70-02589

FREE AND COMMON SHELLFISHERIES.

R I Gen Laws Ann secs 20-9-17 thru 20-9-22, 20-9-26, 20-9-27 (1968).

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Descriptors: *Rhode Island, *Administrative agencies, *Fish management, *Crabs, Regulation, Natural resources, Permits, Shellfish, Oysters, Clams, Mussels, Bays, Inlets, Fish reproduction, Legislation, Fish conservation, Conservation, Legal aspects.

Identifiers: *Coves, Quahaugs, Scallops, Penalties (Criminal).

The taking of blue and sand crabs is regulated. Only residents may take such crabs. The Director of Natural Resources may designate waters from which such crabs shall not be taken. Blue crabs may be taken only during the established season. Sex and size limitations are established for blue crabs. Persons violating these provisions are subject to various penalties. Persons taking shellfish at night are subject to fine and imprisonment. Persons trading in shellfish must obtain a license from the Director of Natural Resources. Licenses must deal only with licensed persons. The Director may, after a hearing, suspend licenses for violation of these provisions. License suspensions may be appealed to the superior court. (Duss-Florida)

W70-02590

FISH AND GAME: OYSTER GROUND LEASES.

R I Gen Laws Ann secs 20-10-26 thru 20-10-28, 20-10-30, 20-10-31 (1968).

Descriptors: *Rhode Island, *Oysters, *Beds, Riparian rights, Boats, Leases, Docks, Fish management, State jurisdiction, Regulation, Shellfish, Land tenure, Legislation, Rivers, Aquatic life, Legal aspects, Wildlife conservation, Conservation, Damages.

Identifiers: *Penalties (Criminal), Vessels.

Any person taking oysters from oyster beds at night shall be fined for each offense. Boats and equipment employed in the taking shall be forfeited. Taking oysters from private beds is subject to fine and imprisonment. Persons wilfully damaging private oyster beds shall be fined, and boats and equipment employed shall be forfeited. Persons taking more than two bushels of oysters from Trustan Pond during one day shall be fined. Any constable viewing the commission of these offenses may arrest and detain the offender without warrant. (Duss-Florida)

W70-02591

TOWN CONTROL OF FISHERIES.

R I Gen Laws Ann secs 20-17-1 thru 20-17-4 (1968).

Descriptors: *Leases, Rhode Island, *Shellfish, *Fisherries, Legislation, Ponds, Regulation, Preservation, Riparian rights, Fish, Clams, Oysters, Mussels, Cities, Fish conservation, Shores, Beds, Conservation, Aquatic life, Commercial shellfish, Fish management, Wildlife conservation, Cultivation, Legal aspects.

Identifiers: Quahaugs, Scallops, Penalties (Criminal).

The electors of Tiverton may make regulations for the preservation of fish and may control the fisheries of Nomquit Pond within the town limits. The electors of New Shoreham may enact ordinances to protect and regulate the taking of shellfish and other fish in Great Salt Pond. Penalties may be imposed for violations of such ordinances. Subject to the rights of riparian owners, the town council of New Shoreham is authorized to regulate shell fisheries in Great Salt Pond by leasing one-acre lots to inhabitants of the state. Such leases are for the protection and cultivation of shellfish. Persons interfering with the rights of lessees or taking shellfish from their grounds without permission shall be fined for each offense. (Duss-Florida)

W70-02592

FISHING LICENSES.

R I Gen Laws Ann secs 20-5-1 thru 20-5-15 (1968).

Descriptors: *Rhode Island, *Fishing, *Permits, *Fish management, Regulation, Control, Fish, Fish conservation, Conservation, Wildlife conservation, Management, Fish guiding, Fishing stocking, Riparian rights, Stream improvement, Wildlife management, Hunting, Water sports, Wildlife, Recreation, Sport fishing, Legislation.

Regulations relating to the issuance of fishing licenses are provided. All money received from license fees is appropriated for: (1) the protection and propagation of fish and game; (2) the leasing of land and rights-of-way to streams and ponds to be stocked with fish; (3) stream improvement; and (4) fish and game law enforcement. The Director of the Department of Natural Resources has jurisdiction over all matters in the chapter and makes all needed regulations for the enforcement of this chapter. (Smith-Florida)

W70-02598

W70-02639

LANDS MAY BE GRANTED OR EXCHANGED TO PROMOTE BOATING.

Wis Stat Ann sec 27.115 (1964).

Descriptors: *Wisconsin, *Boating, *Beds, *Sailing, Legislation, Legal aspects, Navigation, Naval architecture, Ownership of beds, Recreation, Recreation facilities, Local governments, Cities, Water sports.

Identifiers: Naval science.

Any city or county which has acquired or may hereafter acquire title to the bed of any lake is authorized to transfer that title to any incorporated yacht club under certain conditions. The principal purposes of a yacht club, in order for it to qualify, must be the development and encouragement of boating, sailing, yacht building, naval architecture and science, and nautical knowledge, customs and beliefs. A city or county may either grant land to the yacht club or exchange for land owned by the yacht club. Such conveyances are valid so long as the yacht club uses the land for the purposes enumerated above. (Keith-Florida)

W70-02682

CULTIVATION OF FISH.

R I Gen Laws Ann secs 20-4-9 thru 20-4-15, 20-4-20 (1968).

Descriptors: *Rhode Island, *Fish reproduction, *Fisherries, *Fish management, Fish, Fish hatcheries, Reproduction, Regulation, Fish ladders, Fish passages, Fish migration, Fish guiding, Fish conservation, Wildlife management, Fish barriers, Life cycles, Legislation, Management, Conservation, Wildlife conservation, Administrative agencies, Natural resources, Legal aspects.

For the purpose of protecting and propagating fish and providing public fishing preserves the Director of Natural Resources may acquire any land, stream, lake, pond, or any part thereof upon such conditions as the owner and Director may agree upon. The Director may summarily seize and remove all obstructions to the growth, culture, or passage of fish. It is unlawful to rebuild any such structure or to fish in waters set aside for the cultivation of fish. It is unlawful to catch fish by hook and line from fisheries for three years after such fishery was stocked, except for certain black bass fisheries. An open season is set for waters set aside for shad and salmon cultivation. It is unlawful to use any seine or catch any fish within half a mile of any fishery. The Department may take fish from any fishery for fish culture or scientific observation purposes. The exclusive right to own, cultivate, and control all fish or shellfish in a pond artificially created by excavation shall belong to the proprietors thereof, whether such fish be artificially or naturally propagated. Certain restrictions apply to such cultivation. (Smith-Florida)

W70-02599

CULTIVATION OF FISH.

R I Gen Laws Ann secs 20-4-1, 20-4-2, 20-4-5, 20-4-8 (1968).

Descriptors: *Rhode Island, *Fish hatcheries, *Fish management, *Fisherries, Fish populations, Fish establishment, Regulation, Fish, Reproduction, Wildlife conservation, Conservation, Fish conservation, Fish reproduction, Fish stocking, Shellfish, Research and development, Legislation, Administration, State governments, Aquatic life, Aquatic animals, Aquaculture, Inland waterways, Shores, Seashores.

The Director of Natural Resources may make any experiments in cultivating and developing all kinds of shellfish and for such purpose may hold and occupy exclusively any portion of the shores of the public waters or land within the state. The Director may make regulations for the protection of such areas and their animal life. The Department of Natural Resources may introduce, protect, and cultivate fish in the inland waters of the state and may make regulations for the protection of such fish. It is unlawful for any person to violate these regulations or to take any fish, fish spawn, or any apparatus used in hatching or protecting fish, without the consent of the person cultivating the same. (Smith-Florida)

W70-02718

FISHING BY NON-RESIDENTS.

R I Gen Laws Ann secs 20-6-1 thru 20-6-4 (1968).

Descriptors: *Rhode Island, *Fishing, *Trawling, *Permits, Commercial fishing, Fish, Fish harvest, Fishing gear, Equipment, Fish management, Fish conservation, Regulation, Administration, Wildlife management, State jurisdiction, Fishing, Lobsters, Aquatic animals, Commercial shellfish, Bass, Natural resources, Legislation.

No persons except citizens of this state shall take fish with or set any kind of beam or otter trawl in the public waters of this state. In certain locations it is unlawful for any person, firm, or corporation to operate otter trawls or beam trawls. It is unlawful for non-residents to take lobsters, tautog, bass, or other fish away in vessels. Any non-resident who holds a Connecticut fishing license may fish by angling in certain locations without a license from this state, provided such non-resident is subject to all the statutes of this state and provided Connecticut grants like privileges to holders of Rhode Island licenses. A non-resident who is a resident of a state which grants reciprocal privileges to Rhode Island citizens may apply to the Director of Natural

VIGILANCE OVER RESERVOIRS,

Gruner Brothers, Basle (Switzerland).

Edward C. Gruner,

Water and Water Eng, Vol 73, No 883, p 369-373, Sept 1969, 5 p, 30 ref.

Descriptors: *Dam construction, *Safety, *Reservoir construction, *Regulation, *Reservoir operation, Flood protection, Damages, Safety factors, Rock mechanics, Instrumentation, Dam failure, Erosion, Nuclear energy.

Identifiers: Dam safety, Reservoir safety.

This article describes in general terms a project on 'Safety of Reservoirs' developed by UNESCO aiming at a diffusion of experience gained on existing dams for further design, construction, modification, operation or removal of dams and reservoirs. The study includes case histories, principles, condensed experience, an abstract of regulations, and a bibliography of water power regulations in France, Italy, Japan, Norway, Spain, Switzerland, USSR, Poland, Czechoslovakia, United Kingdom, and the USA. (Gabriel-USGS)

Resources for a license to fish by beam or otter trawl. The Director may suspend or cancel any such license when the public interest requires. (Smith-Florida)
W70-02732

ALLOCATIVE IMPACTS OF FEDERAL AND STATE WATER DEVELOPMENT LAW,
California Univ., Los Angeles Dept. of Economics.
David L. Shapiro.
California Water Resources Center, Technical Completion Report WRC No WI88, Nov 1969. 3 p. OWRR Project B-065-CAL.

Descriptors: *Water allocation, *Water rights, *Water transfer, Legal aspects, Water resources development.

One aspect of the research focused on the interactions of California water law and federal water development law. Problems arose out of the difficulties of transferring water rights in the Central Valley Project, creating inefficiencies. The second phase of the work involved a search for devices to avoid such legally created anomalies. One approach was based on the issuance of transferable paper titles, and the second approach was based on the title insurance concept applied to water rights. Either plan, properly implemented, would correct the main impediment to transferability. Another phase of the work concerned improvements in existing water development law. One topic studied concerned the discount rates used to calculate future benefits and costs, and the analysis indicated the newly existing rates not sufficiently high. The author further suggests the use of incremental benefit-cost analysis. Another approach suggested the policy of having an adversary government agency review the work of planning agencies before authorization.
W70-02736

PROTECTION OF FISHING GROUNDS.
R I Gen Laws Ann secs 20-3-1 thru 20-3-4 (1968).

Descriptors: *Rhode Island, *Fish management, *Tidal waters, *Fishing, Fish, Baits, Boats, Ships, Oil wastes, Brines, Oysters, Aquatic animals, Aquatic life, Regulation, Legislation, Conservation, Water conservation, Fish conservation, Water resources development.

It is unlawful to deposit fish offal or water impregnated with fish in public tidewaters unless filtered in accordance with regulations of the town wherein such deposit is to be made. Every vessel used for procuring fish oil or for dressing bait and other fish in violation of this chapter shall be liable for all prosecution costs, and such vessel may be attached to secure any possible judgment. It is unlawful to press fish for extracting oil on board any vessel on any public tidewaters. It is unlawful to wilfully place brush, trees or limbs in any waters of Charlestown Pond, except for the protection and cultivation of oysters. (Smith-Florida)
W70-02737

THE USE OF STREAM CHANNELS TO DELIVER STORED WATER: THE POSSIBILITY OF INTERFERENCE BY THIRD PARTIES,
North Carolina Univ., Chapel Hill.

Douglas R. Gill.
Available from the Clearinghouse as PB-188 916, \$3.00 in paper copy, \$0.65 in microfiche. Report No 32, Water Resources Research Institute of The University of North Carolina, Dec 1969. 34 p. North Carolina Project NC-WAR-1.

Descriptors: *Water law, *Riparian rights, Water rights, Water transfer.
Identifiers: Stream channels, Impounded waters.

This report is addressed to one aspect of the adaptation of old water rights law to contemporary conditions: legal issues associated with the use of stream channels to deliver stored water from im-

poundments. It identifies three possible threats of interference with these uses of stream channels for transmitting stored water. First: intervening riparian land owners might successfully object to the use of the channel for such artificial water carriage. Second: intervening riparian land owners might be able to intercept the released water before it reaches its destination, and without legal recourse by the intended beneficiary of the storage. Third: owners of riparian land situated below the point of intended use may be able to raise enforceable legal objections against a proposed withdrawal for public water supply purposes. Under existing riparian rights law in North Carolina, the report concludes, the first threat is probably insubstantial, while the second and third threats are significant. There may be some possibilities of moderating these risks in some cases via equitable concepts or doctrines of sovereign immunity or inverse condemnation. For the long run, however, it is difficult to imagine an efficient stored water system being operated under North Carolina law as it seems presently to exist. (p 33). The report points to the possibility of legislative solutions, suggesting that further research is needed to explore legal aspects of such solutions, including possible constitutional issues. (Howells-North Carolina)
W70-02765

LEASING OF TOLL BRIDGES.

Pa Stat Ann tit 16, secs 5841, 5852 (1956).

Descriptors: *Pennsylvania, *Bridges, *Leases, *Local governments, Structures, Bridge construction, Construction, Public utilities, Highways, Jurisdiction, Railroads, Rivers, Streams, Contracts, Maintenance, Public benefits, Legislation.

Whenever a bridge company's toll bridge is used solely by the public for general highway purposes, or concurrently with a public railroad company, the county commissioners of any interested county may lease such bridge or portions thereof for use by the public for general highway purposes and free from the payment of tolls. Where a municipality is authorized to construct a bridge or viaduct over a river, creek, or stream over which the county is also authorized to build such bridges, and such municipality is authorized to contract with interested parties, railroad companies, or county governments for the construction and maintenance of such structures, the county commissioners with court approval may contract with such municipality for the portion of such structure which the county might have built. (Smith-Florida)
W70-02805

TAKING UP DRIFTING LUMBER.

Pa Stat Ann tit 32, secs 511-518 (1967).

Descriptors: *Pennsylvania, *Lumber, *Boats, *Rivers, Ohio River, Delaware River, Legal aspects, Lumbering, Damages, Riparian rights, Legislation.

Identifiers: Barrels, Oil barrels, Drifting lumber.

Any person may take up lumber of any kind or any flat-boat floating upon the waters of the Ohio, Allegheny, or Monongahela rivers or any of their tributaries by posting a list and description of such lumber or flat-boat in a conspicuous place in the town or borough where such lumber or flat-boat was found. If the true owner does not call for and take away the same within three months, such lumber or flat-boat shall become forfeited to the person taking up the same. Any person so taking up lumber or flat-boats shall be reimbursed by the owner at set rates, and such person shall be liable for damages for failure to comply with this act. These provisions shall apply to full or empty oil barrels. Persons securing drifting lumber in the Schuylkill or Delaware rivers are entitled to compensation from the owner. It is the duty of any person in possession of previously drifting lumber to safely store the same, advertise the same in a local newspaper for four weeks, sell the same at public

sale, and keep the proceeds for one year. (Smith-Florida)
W70-02806

SUSQUEHANNA AND LEHIGH RIVERS AND THEIR TRIBUTARIES, TREES, LUMBER, AND TIMBER THEREIN.

Pa Stat Ann tit 32, secs 541, 544, 551-552, 559 (1967).

Descriptors: *Pennsylvania, *Lumbering, *Flotsam, Legislation, State governments, Administration, Islands, Regulation, Tributaries, Legal aspects, Saw mills, Transportation.

Any person finding logs, shingles, boards, or lumber floating in the Susquehanna or Lehigh rivers has a duty to list the quality and quantity of such materials with the court. Publication of the finding shall be made. Unclaimed materials shall be forfeited to the finder. Owners and occupiers of islands in the Susquehanna River may act in accord with the provisions of this act with regard to lumber lodging on said islands. All persons placing lumber in the river above the Susquehanna boom must adopt a mark to be placed on such lumber which is to be registered in writing with the court. Certificates of registration are *prima facie* evidence of the right to use such marks. No two persons shall have the same mark. All saw logs to be floated down the Susquehanna River between Northumberland and the Maryland state line must be rafted and joined together or enclosed in boats and under the control and supervision of men thereon. All loose logs are subject to capture and possession unless the owner makes timely demand and nominal payment for them. (Barnett-Florida)
W70-02807

MUNICIPAL ASSISTANCE.

Pa Stat Ann tit 32, secs 802-806 (1967).

Descriptors: *Pennsylvania, *Local governments, *Financing, *Water conservation, State governments, Costs, Construction costs, Flood control, Flood protection, Water resources development, Legal aspects, Legislation, Projects, Project planning, Administrative agencies, Cities.

Any municipality is authorized to increase its indebtedness within state-established limits for the purpose of assisting the state in the construction or completion of any project or improvement for water conservation or flood control. Moneys may be appropriated by the municipalities only for expenditure on projects authorized by law. The state hereby declares its intention to repay funds advanced by the municipalities for water conservation and flood control projects. The Department of Forests and Waters shall have full power to use and expend funds advanced by municipalities for these purposes. (Kelly-Florida)
W70-02808

FISHING REGULATIONS APPLYING TO BOUNDARY RIVERS.

Pa Stat Ann tit 30, secs 110-158 (Supp 1969).

Descriptors: *Pennsylvania, *Fishing, *Delaware River, *Fishing gear, Fish, Regulation, Fish management, Legislation, State governments, Administrative agencies, State governments, Rivers, Bait fishing, Commercial fishing, Sport fishing, Fish conservation, Baits, Bait traps, Nets, Legal aspects, Fish harvest, Fish types, New York.

In setting forth fishing regulations applying to Pennsylvania's boundary rivers, this act establishes three differing articles affecting the Delaware River: provisions applying to the river above Trenton Falls; provisions applying to the river below Trenton Falls; and provisions applying to that portion of the river between Pennsylvania and New York. The articles, although varying in substance concern: (1) definitions of game fish, bait

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

fish, and food fish; (2) permissible fishing devices for game fish, bait fish, and food fish; (3) seining for sturgeon and food fish; (4) stakes and fastened nets; (5) closed seasons for food fish, game fish, the use of nets, and the use of eelpots and fyke nets; (6) legal sizes and creel limits; (7) penalties for damage to nets and seines; (8) the use of nets on Saturdays and Sundays; (9) concurrent jurisdiction of states; (10) the sale of fish; (11) size of mesh for nets and seines; (12) closed seasons on shad; (13) taking fish for bait, scientific and stocking purposes; and (14) seizure of illegal devices. (Marsee-Florida)
W70-02809

DAMS, FISHWAYS, BAR-RACKS, OBSTRUCTIONS.

Pa Stat Ann tit 30, secs 185-196 (Supp 1969).

Descriptors: *Pennsylvania, *Fish passages, *Fish barriers, *Fish migration, Dams, Fish, Fish ladders, Intakes, Fish establishment, Fish stocking, Costs, Fish handling facilities, Fish conservation, Wildlife conservation, Fishing, Sport fishing, Fishing gear, Control, Animal control, Water conservation, Administrative agencies, Legal aspects, Legislation, State governments, Engineering structures.

Persons hereinafter erecting or maintaining dams in state waters must, upon written order from the Pennsylvania Fish Commission, erect such chutes, slopes, fishways, gates, or other devices as are necessary to enable fish to ascend and descend the waters in all seasons. Alternatively the Commission may elect to receive from such persons the sums of money herein specified to be applied to fish stocking and management. The above devices must be maintained in good working order and may be closed for repairs no longer than thirty days at one time. Where the persons notified fail to erect requested devices, the Commission may erect the devices and collect the costs from those persons. The Commission shall pay the cost of installing devices except in already existing dams. Drawing off of waters inhabited by fish or interfering with dams requires Commission approval. Fishing near dams and devices except with rod and line and preventing the migration of fish are prohibited. Persons maintaining raceways, flumes, or inlet-pipes leading to a water-wheel, turbine pump, or canal must place bar-racks to prevent fish from entering therein. (Marsee-Florida)
W70-02810

BRIDGES OVER NAVIGABLE WATERWAYS AND RAILROADS.

Pa Stat Ann tit 36, secs 2911-2913 (1961).

Descriptors: *Pennsylvania, *Bridges, *Navigable waters, *Railroads, Navigable rivers, Navigation, Bridge construction, Construction, Bridge design, Dams, Canals, Barriers, Obstruction to flow, Lumbering, Rivers, Streams.

No bridge, frame or device shall be erected or sustained over any navigable waterway if such device in any way hinders the navigation of any craft or float of logs. This shall not limit maintaining and repairing drawbridges and public bridges or the making of dams, mounds, or tide banks for the draining of low grounds and improving meadows. The laws relative to the erection of bridges over rivers and creeks are extended to the erection of bridges over canals and railroads. Bridges shall not obstruct the canal or railroad over which such bridge is erected. (Smith-Florida)
W70-02811

AUTHORITY TO ERECT BRIDGES.

Pa Stat Ann tit 36, secs 2972-2989.49 (1961), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Bridges, *Rivers, *Bridge construction, Streams, Eminent domain, Condemnation, Public lands, Highway relocation, Road construction, Highways, Structures, State governments, Administration, Legislation, Railroads.

The Department of Highways, with the Governor's approval, is authorized to erect bridges at named locations over the Susquehanna, Monongahela, Allegheny, Clarion, Chester, and Schuylkill Rivers and over certain railroad tracks in Altoona. Said Department is authorized to acquire the necessary land for approaches thereto and shall have all powers conferred with respect to relocation, widening or construction of highways. Several of said bridges shall be toll bridges until such time as the costs of constructing or acquiring said bridge shall be paid. The other bridges shall be toll free and maintained by the Department of Highways. (Smith-Florida)
W70-02812

DELAWARE RIVER BRIDGE COMPACT.

Pa Stat Ann tit 36, secs 3511, 3512, 3521 (1961).

Descriptors: *Pennsylvania, *Interstate compacts, *Bridge construction, *Delaware River, Highways, Bridges, Administration, Administrative agencies, Tunnels, Tunnel construction, Tunneling, Underground, Structures, Rivers, Streams, Navigable waters, Navigable rivers, Transportation, Construction, Legislation, New Jersey.

The Governor is authorized to enter into a compact with New Jersey in substantially the following form: The Pennsylvania Turnpike Commission and the New Jersey Turnpike Authority are empowered to locate and make plans for a bridge across the Delaware River to connect the turnpike systems of both states. Said Commission and Authority are empowered to enter into agreements setting forth the details of erecting and maintaining such bridge. Upon coming into force, such Compact shall be binding upon Pennsylvania and the Pennsylvania Turnpike Commission and shall have the force and effect of a statute. The Governor shall appoint three citizens to the Delaware River Bridge and Tunnel Commission to plan and construct one or more bridges or tunnels as may be necessary for traffic over or under all navigable streams or rivers which streams or rivers are boundaries of this state. (Smith-Florida)
W70-02813

DELAWARE RIVER TUNNEL AND BRIDGE.

Pa Stat Ann tit 36, secs 3561, 3581 (1961), as amended, (Supp 1969).

Descriptors: *Delaware River, *Bridge construction, *Tunnel construction, *Pennsylvania, Rivers, Bridges, Construction costs, Financing, Interstate rivers, Tunnels, Delaware, Highways, Planning, Cost analysis, Project planning, State governments, Legal aspects, Legislation, Administrative agencies, Transportation, Port authorities.

The Delaware Tunnel Board is authorized to construct and operate a tunnel or tunnels under the Delaware River, connecting Pennsylvania with New Jersey, to facilitate vehicular traffic between the two states. The Delaware River Port Authority is empowered to finance, construct, acquire, and maintain a new toll bridge and such approaches thereto as are deemed necessary. The Authority is to proceed according to a plan approved by the legislatures of Pennsylvania and New Jersey. The new bridge is to be used for vehicular traffic and is to be built across the Delaware River. (Kelly-Florida)
W70-02814

FISH AND GAME.

Wis Stat Ann secs 29.135, 29.137, 29.14, 29.145 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Permits, *Fish, *Baits, Administrative agencies, Rough fish, Minnows, Shellfish, Fish handling facilities, Commercial fish, Fish harvest, Transportation, Regulation, Frogs, Crayfish, Fish hatcheries, Bait traps, Smelts, Inland waterways, Nets, Legislation, Supervisory control (Powers).
Identifiers: *Bait dealers, *Fish dealers, Licensing.

Fish dealers must be licensed by the Conservation Commission. Licensees shall transport only properly labeled packaged fish. The licensee shall keep a record of all purchases of fish. Licenses from the Commission are likewise required for bait dealers. Bait is defined as any frog, crayfish, or minnow used for fishing. The Commission may regulate methods of taking, handling, and storing bait, equipment used, and may require reports from dealers. All bait dealers shall keep proper records of wholesale transactions in the production, buying, and selling of bait. The Commission shall regulate by permit the taking of bait from specified waters. These provisions do not apply to bait produced in licensed private fish hatcheries. Criminal sanctions are provided for violations of the provisions. With limited exceptions, a fishing license is required to fish in inland waters. (Dearling-Florida)
W70-02815

CONSERVATION ACT.

For primary bibliographic entry see Field 03D.
W70-02816

POWER OF BOARD OF COMMISSIONERS OF NAVIGATION TO LICENSE PILOTS.

Pa Stat Ann tit 55, secs 31, 41 thru 44 (1964).

Descriptors: *Pennsylvania, *River regulation, *Permits, *Navigable rivers, Legislation, State governments, Administration, Harbors, Inland waterways, Navigation, Boating regulations, Inspection, Boats, Transportation.

Identifiers: Pilots, Examinations, Qualifications, Licenses.

The Commissioner of Navigation has authority to grant licenses to persons to act as pilots on the Delaware River and to make and publish rules governing pilots and penalties for their breach. They decide differences arising between owners, pilots, and consignees of ships. Such decisions are reviewable by the court of common pleas. All current pilots are entitled to receive a license and subsequent renewals. No new pilots' licenses will be distributed until the class of current pilots is reduced. Those wishing to be a pilot must apply to the Commission, who will judge their qualifications on examination by a first class pilot. Classification of pilots will be determined by capability of piloting ships of different drafts. Licenses are valid for one year. Piloting a ship over seventy-five tons without a valid license is a misdemeanor. The fee for licensing is fifty cents. The qualifications for a pilot's license are listed. (Barnett-Florida)
W70-02817

RIGHT TO RUN TUNNEL UNDER RIVER TO COAL MINE.

Pa Stat Ann tit 52, sec 2 (1966).

Descriptors: *Pennsylvania, *Coal mines, *Navigable rivers, *Tunnel construction, Legislation, Tunneling, Tunnels, Mining engineering, Mining, Excavation, Underground structures, Construction, Maintenance, Administrative agencies, Administrative decisions, Streambeds, Ownership of beds, Submerged lands.

Whenever the power or manufacturing or mining plant of any company is situated upon the bank of any navigable stream and the company has the right to mine coal from land on the adjacent bank, such company may construct, operate, and maintain tunnels under said stream. These tunnels shall serve to connect the coal lands with said power or mining plant of the company. Before any company begins the construction of any tunnel, it must make application to, and secure the approval of, the Water and Power Resources Board. Companies constructing such tunnels shall pay to the Commonwealth of Pennsylvania the fair market value for all coal mined in constructing said tunnel. (Schram-Florida)
W70-02818

MINING SAFETY ZONES.

Pa Stat Ann tit 52, sec 3101 (1966).

Descriptors: *Pennsylvania, *Mining, *Safety, *Hazards, Zoning, Legislation, Regulation, Streams, Rivers, Bodies of water, Natural streams, Artificial watercourses, Administrative decisions, High water mark, Banks, Beds, River beds, Streambeds.

A safety zone is established beneath and adjacent to every stream, river, and natural or artificial body of water that is sufficiently large to constitute a hazard to mining in the opinion and in the discretion of the Department of Mines and Mineral Industries. Such safety zone shall extend horizontally two hundred feet from either the high water mark or known perimeter of the body of water. In any case, the zone shall extend downward to the limit of the workable beds. (Schram-Florida)
W70-02819

COUNTY'S RIGHT OF ENTRY FOR CONSTRUCTION.

Pa Stat Ann tit 16, secs 5905-5907, 5912 (1956).

Descriptors: *Pennsylvania, *Construction, *Bridges, Legislation, Maintenance, Culverts, Boundaries, Transportation, Roads, Storm drains, Channels, Ditches, Local governments, Damages, Alteration of flow, Obstruction to flow, Supervisory control (Power), Structures.

In the construction or maintenance of any county road or highway, the county is authorized to enter upon any private property except a railroad company's right-of-way. Such entrance is allowed for maintenance or construction of storm water drains, ditches, channels, and the inlets thereto. The county must pay any damages incurred by the owner of the land entered upon. Impairing or damaging any drain, channel, or ditch within the county by stopping or diverting the course of it shall be punishable by fine upon conviction before a magistrate. Roads forming or intended to form a continuous highway from one county to another and which cross a river, creek, or rivulet that forms the boundary line of those counties may be laid out, altered or vacated in the manner provided for other roads, except that such alteration is subject to judicial control. (Barnett-Florida)
W70-02825

FLOATING LUMBER ON THE DELAWARE RIVER.

Pa Stat Ann tit 32, secs 481, 485-487 (1967).

Descriptors: *Pennsylvania, *Lumber, *Delaware River, *Lumbering, Legal aspects, Barriers, Obstruction to flow, Structures, Concrete structures, Dams, Walls, Diversion structures, Piers, Damages, Riparian rights, Tidal waters, Legislation.
Identifiers: Drifting lumber, Rafts.

All persons taking possession and safely securing lumber found adrift in the Delaware River shall be entitled to compensation from the owner of such lumber at set rates. Where lost lumber shall lodge upon the shore of the Delaware River, the owner of such shore shall advertise the lumber according to law and if the owner of such lumber does not appear, the owner of such shore may appropriate such lumber to his own use. Upon appearing, the owner of such lumber shall compensate the owner of the shore at set rates. When any lumber in raft is injured in consequence of piers, dams, wings, walls, or other obstructions in the Delaware River, an impartial umpire shall assess the damages and make an award. This shall not apply to loose rafts or rafts in the tidewaters. (Smith-Florida)
W70-02826

TRANSFER OF POWERS.

Pa Stat Ann tit 32, secs 815.102-815.106 (1967).

Descriptors: *Pennsylvania, *Interstate commissions, *Delaware River Basin Commission, State governments, Water resources development, Interstate rivers, *Administrative agencies, Interstate compacts, Delaware River, Delaware, Financing, Government finance, Legislation, Legal aspects, Water conservation supervisory control (Powers).

The functions and powers of the Interstate Commission on the Delaware River are hereby transferred to the Delaware River Basin Commission. All funds and properties which may be in the possession of the state and which are being held for the former body are to be transferred to the Delaware River Basin Commission. The dissolution of the Interstate Commission on the Delaware River and the transfer of its properties shall not be construed as a disavowal of any current activity or program of that body. (Kelly-Florida)
W70-02830

ARTIFICIAL PROPAGATION LICENSES AND SEINE LICENSES.

Pa Stat Ann tit 30, secs 160-165, 170-177, 179-181 (Supp 1969).

Descriptors: *Pennsylvania, *Nets, *Permits, *Fish hatcheries, Fish, Fisheries, Fish farming, Fish handling facilities, Fish management, Fish conservation, Legal aspects, Legislation, State governments, Federal government, Farm ponds, Fish establishment, Administrative agencies, Fishing gear, Carp, Herrings, Tidal waters, Fish eggs, Fry, Fish stocking, Baits.

The Pennsylvania Fish Commission is authorized to: (1) issue seine licenses; (2) regulate the kinds and mesh size of seines which may be used; (3) govern the content, expiration, and production of such licenses; (4) limit seine use to tidal waters, specific kinds of fish, and designated seasons; and (5) require the consent of the seine owner for removal of fish from seines. Fish artificially propagated are not subject to the seine license provisions. The Pennsylvania Fish Commission is authorized to: (1) issue artificial propagation licenses; (2) regulate the issuance of live bait licenses; (3) limit the authority under propagation license; (4) restrict the waters usable for commercial propagation and prohibit devices interfering with fish migration; (5) regulate the sale of fish, bait fish, and fish bait; (6) provide for the inspection of the books and property of license holders; (7) prohibit stocking with fish or eggs from Commonwealth waters; (8) make specific acts related to propagation unlawful; and (9) accord the federal government the right to establish fish-cultural stations in Pennsylvania. (Marsee-Florida)
W70-02831

WILDLIFE CONSERVATION.

Wis Stat Ann secs 29.148, 29.16, 29.174 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Wildlife conservation, *Regulation, *Permits, Legislation, Legal aspects, Administrative agencies, Michigan, Minnesota, Iowa, Fishing, Clams, Interstate compacts, Inland waterways, Recreation, Fish conservation, Wildlife management.
Identifiers: *Sturgeons.

A valid license is required for taking sturgeon by spear. So long as the states of Michigan, Minnesota, or Iowa confer upon the licensees of Wisconsin reciprocal rights, fishing and clamming licenses issued by those states will be recognized by Wisconsin in boundary waters. Seasons, bag limits, and size limits for the taking of game and fish are to be established and maintained. It is the responsibility of the State Conservation Commission to establish such regulations so as to conserve the wildlife supply and insure the citizens of the state continued opportunities for good fishing, hunting, and trapping. The method by which the Commission is to establish regulations governing the foregoing matters is provided. The Commission is directed to

perform such acts as are necessary to conduct and establish a wildlife restoration project in compliance with certain acts of Congress. (Keith-Florida)
W70-02835

FISH AND GAME.

Wis Stat Ann secs 29.38, 29.39, 29.43, 29.44, 29.47, 29.475, 29.48 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Wildlife, *Permits, *Fish conservation, Administrative agencies, Regulation, Transportation, Personnel, Inland waterways, Indian reservations, Interstate, Commercial fishing, Wildlife management, Clams, Mussels, Legal aspects, Seasonal, State governments, Legislation.

It is unlawful to catch or kill mussels or clams during the close season or to have possession of any game or game fish other than in the open season. Transportation of game and fish other than in the open season is forbidden. No game may be transported in trunks or valises on any common carrier. All shipments of game must be clearly labeled. No game may be transported interstate or received interstate in violation of the laws of other states where such game was taken unless taken under license duly issued by that state. Transportation of fish from inland waters is strictly regulated with regard to amount, type, and weight. Separate restrictions are placed on fish from outlying waters. The sale of game and fish is unlawful during the close season whether taken lawfully within or without the state. Fish taken from outlying waters are subject to the commercial fishing regulations. (Barnett-Florida)
W70-02837

BRIDGES MADE SAFE.

Wis Stat Ann sec 195.31 (1957).

Descriptors: *Wisconsin, *Bridges, *Safety, *Railroads, Legislation, Legal aspects, Administrative aspects, Streams, Bridge construction, Maintenance, Repairing, Costs, Cost allocation, Damages, Cities.

When specified parties file a complaint with the Public Service Commission to the effect that a railway bridge over a stream is unsafe, the Commission will hold a hearing. If it is found that the railway bridge is unsafe, the Commission will determine what type of alteration, repair, or reconstruction is necessary to insure safety. The Commission will then apportion costs, damages, and expenses among the railroad company and other parties in interest. (Keith-Florida)
W70-02839

RIVERS; LAKES; NAVIGABLE WATERS; STATE JURISDICTION.

Wis Const Art IX sec 1 (1848).

Descriptors: *Wisconsin, *Jurisdiction, *Navigable waters, *Transportation, Legislation, Legal aspects, Rivers, Lakes, Boundaries (Property), Mississippi River, St. Lawrence River, United States, Taxes, Tariff.

Wisconsin will have concurrent jurisdiction on all rivers and lakes which form a boundary common to Wisconsin and another state. The Mississippi River and the navigable waters leading into the Mississippi and St. Lawrence rivers will be common highways and forever free to all citizens of the United States to use without charge. (Keith-Florida)
W70-02840

JURISDICTION OF COUNTIES ON BOUNDARY WATERS.

Wis Stat Ann secs 2.03, 2.04 (1967).

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Descriptors: *Wisconsin, *Jurisdiction, *Boundaries (Property), *Streams, Legislation, Legal aspects, Rivers, Lake Michigan, Lake Superior, Mississippi River, Piers, Docks, Channels, Local governments.

Identifiers: Inland waters.

When two counties are separated by a river or stream, the middle of the main channel of such river or stream will be the division line between them. Counties so separated will have common jurisdiction of all offenses committed on the waters between them. The jurisdiction of counties on specified boundary lakes and state boundary waters is fixed by giving joint jurisdiction to the counties on a directional side of the body of water in question. When two or more counties bound any inland water of the state, they will have jurisdiction in common of all offenses committed on any part of such inland water. (Keith-Florida)

W70-02841

POWERS OF THE DEPARTMENT OF RESOURCE DEVELOPMENT.

For primary bibliographic entry see Field 04A.

W70-02842

6G. Ecologic Impact of Water Development

SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK,

Geological Survey, Miami, Fla. Water Resources Div.

For primary bibliographic entry see Field 04C.

W70-02631

A PRELIMINARY ECOLOGICAL SURVEY OF THE WATER RESOURCES AND LAND USE PATTERNS OF THE DISMAL SWAMP AREA OF VIRGINIA,

Virginia Polytechnic Inst., Blacksburg.

C. Duke Wilder, Jr., Paul M. Brady, George M.

Simmons, Stuart E. Neff, and L. A. Hart.

Project Completion Report, Virginia Water Resource Research Center, 1969. 4 p. OWRR Project A-020-VA.

Descriptors: *Aquatic habitats, *Ecology, *Fish populations, Limnology, Primary productivity, Vegetation, Water resources, Wetlands, Temperature, Acidity, Salinity, Oxygen levels.

Identifiers: *Dismal Swamp, *Lake Drummond.

A detailed analysis of the fish populations was made and some suggestions were made concerning fish management in Lake Drummond. Information was acquired on temperature, oxygen levels, acidity, salinity, and primary productivity. Aerial photography of a selected portion of Dismal Swamp was flown using several film and filter techniques. It was concluded that the most important single need for an understanding of the environment of Dismal Swamp is a one- or two-year detailed limnological study. There is an indication from this study that the basic physical and chemical conditions of the water are not conducive to a high, balanced, biological productivity; but this aspect required much more detailed study.

W70-02746

ECOLOGY OF SELECTED AQUATIC BACTERIA IN THE SNAKE RIVER,

Washington State Univ., Pullman.

For primary bibliographic entry see Field 05C.

W70-02762

07. RESOURCES DATA

7A. Network Design

DATA ERROR EFFECTS IN UNIT HYDROGRAPH DERIVATION,

New South Wales Univ., Sydney (Australia). Dept. of Civil Engineering and Imperial Coll. of Science and Technology, London (England).

Eric M. Laurenson, and Terence O'Donnell.

ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6887, p 1899-1917, Nov 1969. 19 p, 7 fig, 6 tab, 10 ref, append.

Descriptors: *Hydrograph analysis, *Unit hydrographs, *Rainfall-runoff relationships, *Flood forecasting, Streamflow forecasting, Sampling, Rain gages, Discharge (Water), Hyetographs, Hydrographs, Hydraulics, Hydrology, Data processing.

Identifiers: Hydrograph synthesis.

Errors in rainfall and streamflow data cause errors in derived unit hydrographs. The effects of various types of data error on unit hydrographs derived by various methods have been examined. The data errors studied were those in the loss-rate assumption, total rainfall measurement, the discharge rating curve, base-flow separation, and time synchronization of rain gages and streamflow recorder. The methods of derivation were the harmonic, Laguerre, least squares, and gamma distribution methods. Effects of hyetograph and unit hydrograph shapes were also investigated. It was concluded that unit hydrograph shape had little effect, and that hyetograph shape had little effect except in combination with the Laguerre method, when it was of critical importance. No single method of derivation could be recommended in preference to the others. Synchronization-type data errors and the uniform loss-rate assumption tend to produce significant errors in the unit hydrograph, but the other error types caused surprisingly low errors. (Knapp-USGS)

W70-02454

GENERALIZED ANALYSIS OF SMALL WATERSHED RESPONSES,

California Univ., Davis.

For primary bibliographic entry see Field 02A.

W70-02763

7B. Data Acquisition

TRIANGULAR BROAD-CRESTED WEIR,

Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering and Colorado State Univ., Fort Collins.

Clifford D. Smith, and Wen S. Liang.

ASCE Proc, J Irrig and Drainage Div, Vol 95, No IR4, Pap 6954, p 493-502, Dec 1969. 10 p, 9 fig, 1 tab, 4 ref, append.

Descriptors: *Stage-discharge relations, *Weirs, *Water measurement, Critical flow, Flow measurement, Discharge (Water), Open channel flow, Hydraulics, Discharge measurement, Gaging stations, Gages.

Identifiers: Broad-crested weirs.

The advantages of flow measurement with a thin plate V-notch weir and a broad-crested weir are reviewed briefly. The triangular broad-crested weir is intended to combine the advantages of both in a single structure. The discharge coefficient and limiting submergence are derived from simple theory based on the assumption of critical flow. Details are given for experiments carried out on a weir with a 90 deg notch angle and four different lengths of broad crest. It was found that the actual coefficient was less than theoretical and was not constant; however, the limiting submergence agreed exactly with theory, provided the length of

the broad crest was at least three times the head. A design curve for the coefficient is included.

W70-02449

FRICITION FACTORS FOR FLOW IN SAND-BED CHANNELS,

Massachusetts Inst. of Tech., Cambridge. Hydrodynamics Lab.; and Iowa Univ., Iowa City. Inst. of Hydraulic Research.

For primary bibliographic entry see Field 02J.

W70-02461

ENUMERATION OF AUTOTROPHIC AMMONIUM-OXIDIZING BACTERIA IN MARINE WATERS BY A DIRECT METHOD,

Rutgers - The State Univ., New Brunswick, N.J. Dept. of Environmental Sciences.

M. S. Feinstein.

Applied Microbiology, Vol 16, No 11, p 1646-1649, Nov 1968. 3 fig, 2 tab, 10 ref.

Descriptors: *Marine microorganisms, *Nitrification, *Bacteria, *Methodology, Nitrites, Eutrophication, Analytical techniques, Ammonium salts, Nitrogen cycle, Cycling nutrients, Water pollution effects.

Identifiers: *Autotrophic microorganisms, *Bacteria counting, *Techniques, Most-probable-number technique, Enumeration techniques.

A new method is presented for enumerating those autotrophic nitrifying bacterial colonies capable of oxidizing ammonium to nitrite, and compared with the MPN (most-probable-number) technique. In this method, membrane filtration is followed by 18-25 days incubation of the filter on the surface of glass wool pads saturated with ammonium-rich nutrients. Membranes are then freed of nitrite and incubated on the surface of ammonium-containing agar for 5-30 minutes. Application of standard reagents for nitrite develops colored spots on the agar, coinciding with nitrifying colonies on the membrane, which colonies are dependent on the presence of ammonium in the agar. Membranes with single nitrifying regions caused vigorous nitrification when transferred to mineral salts medium, while membranes without nitrifying regions did not. Author concludes that filter technique is adequately sensitive and more precise than MPN. Results from replicate membrane samples fell within confidence limits of those from replicate MPN samples. Confidence limits of estimates from replicate membrane tests were narrower than those from MPN tests. Only seawater samples were tested, but the technique may be adaptable to fresh waters. Author evaluates advantages and disadvantages for the two methods, and presents a technique for increasing filtration speed. (Gerhold-Wisconsin)

W70-02507

BASIN TRACER CURVES INTERPRETED BY BASIC ANALYTICS,

Bason and Filter Specialty Co., Shreveport, La.

A. Adler Hirsch.

ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 95, No SA6, Paper 6951, p 1031-1050, Dec 1969. 20 p, 7 fig, 2 tab, 25 ref, append.

Descriptors: *Tracers, *Tracking techniques, *Sediment transport, Reservoirs, Watersheds (Basins), Sedimentation, Streamflow, Dye releases, Mathematical studies, Analytical techniques.

Identifiers: Basin tracer curves.

A basin flow tracer test with pulse injection may be characterized as passage of a material shock wave. Virtual transit is related to the maximum slope on the dimensionless time versus concentration curve. The plug point, which separates plug from non-plug flow, is located at the initial arrival of tracer for straight rising or convex upward ascents, and (hypothetically) at the first tangential subinflection of ogive ascents. Plug flow extends from the origin to the plug point; dual flow exists from the plug

Evaluation, Processing and Publication—Group 7C

point to the descending inflectum; beyond that flow is the mixed or eddied type. Short-circuiting is indicated directly by the distance between plug point and nominal detention time. The negative exponent of the semi-logarithmic plot of the decline denotes the number of times the effective fraction of basin volume is extracted by non-plug flow. Curves replotted from the literature confirm this theory. Dispersion is measured by the angle between the tangent to the plug point with the vertical. A concise diagram having plug point and dispersion as coordinates permits comparison of basins. (Knapp-USGS)
W70-02633

MEASURING SUBSURFACE SPRING FLOW WITH RADIOTRACERS.

Federal Water Pollution Control Administration, Dallas, Tex.; and Corps of Engineers, Tulsa, Okla. Engineering Div.

William C. Galegar, and Myron W. DeGeer.

ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 95, No SA6, Paper 6973, p 1097-1103, Dec 1969. 7 p, 4 fig, 2 ref.

Descriptors: *Tracers, *Tritium, *Groundwater movement, *Texas, *Springs, Streamflow, Tracking techniques, Leakage, Seepage, Water pollution sources, Brines, Saline water systems, Aquifers, Karst, Groundwater.
Identifiers: Esteline Spring (Tex).

A hydrostatic head was imposed on Esteline Spring, Texas to prevent surface discharge and subsequent natural salt pollution of the Red River. This paper describes the use of tritiated water as a tracer to determine the rate of subsurface leakage of the Spring, the size of the Spring cavern, and the location of that area where subsurface leakage returns to the surface. Other techniques using salt and organic dyes did not prove successful, due largely to insensitivity in detection and probable losses to adsorption and degradation. The volume of the known spring chimney, including that within the dike, amounts to about 389,800 cu ft. Knowing the amount of tracer added and the initial concentration of tracer after mixing, it was determined that a volume of 493,960 cu ft existed. From these data, it is concluded that a second chamber exists below that which was previously known; and its volume amounts to about 104,000 cu ft. (Knapp-USGS)
W70-02637

A FALLING-PARTICLE CURRENT METER,
Columbia Univ., Dobbs Ferry, N.Y. Hudson Labs.

T. E. Pochapsky.

Report avail from Clearinghouse as AD 679 195, \$3.00 in paper copy, \$0.65 in microfiche. Hudson Laboratories Technical Report No 151, Columbia University, May 1968. 22 p, 7 fig, 1 ref. Contract Nonr-266 (84) ONR.

Descriptors: *Current meters, *Instrumentation, *Ocean currents, Flow measurement, Gages, Currents (Water), Stream gages, Sea water, Velocity, Oceanography, Marine geology, Ocean circulation.
Identifiers: Falling-sphere current meter.

Small dense spheres sink in water with a predictable velocity. A horizontal current deflects the path of sinking and the magnitude of the current can be determined from the horizontal deflection. This procedure can be used to measure very small currents, particularly those below one cm/sec, which are too small to operate most current meters. A meter built to operate on this principle at sea is described. (Knapp-USGS)
W70-02670

A FLUOROMETRIC METHOD FOR DETERMINING TRACE QUANTITIES OF FLUORIDE,
Missouri Univ., Columbia. Dept. of Chemistry.
John C. Guyon, Berwyn E. Jones, and David A. Britton.
Mikrochimica Acta, Vol 6, p 1180-1184, 1968.
OWRR Project A-014-MO.

Descriptors: *Analytical techniques, *Fluorescence, *Fluorides, *Ions, Chemistry, Trace elements.
Identifiers: Determination, Water samples, Anions.

A very selective method has been developed for the determination of ug quantities of fluoride based on the fluorescence quenching by fluoride of the zirconium-flavonol chelate. The fluorescence intensity is read at 460 nm. The reduction in fluorescence intensity caused by the fluoride is a measure of the fluoride concentration present.
W70-02726

A FLUOROMETRIC DETERMINATION OF IODIDE ION,

Missouri Univ., Columbia. Dept. of Chemistry.
David A. Britton, and John C. Guyon.
Microchemical Journal, Vol 14, No 1, p 1-6, Mar 1969. 2 tab, 2 fig, 2 ref. OWRR Project A-014-MO.

Descriptors: *Analytical techniques, Chemistry, *Fluorescence, *Ions, Trace elements.
Identifiers: Determination, Water samples, Anions, *Iodide ion.

A very selective, simple, sensitive fluorometric method for the determination of iodide ion was developed. The method is based on iodide quenching the fluorescence of an uranyl acetate solution. The fluorescence is measured at 520 mu. A nearly linear calibration curve is obtained for 2 to 20 ug of iodide ion.
W70-02727

FLUOROMETRIC DETERMINATION OF OXALATE ION,

Missouri Univ., Columbia. Dept. of Chemistry.
David A. Britton, and John C. Guyon.
Anal Chim Acta, Vol 44, p 397-401, 1969. 2 tab, 1 fig, 4 ref. OWRR Project A-014-MO.

Descriptors: *Analytical techniques, *Fluorescence, *Ions, Chemistry, Trace elements.
Identifiers: *Oxalate ion, Determination, Water samples, Anions.

A very selective, simple, sensitive fluorometric method for the determination of oxalate ion is described. The method on the quenching by oxalate of the fluorescence of a 1M zirconium-flavonol chelate in dilute sulfuric acid solution. The fluorescence is measured at 460 nm. A linear calibration curve is obtained for 0-10 ug of oxalate ion; there are very few interferences.
W70-02728

CURRENT STUDY IN THE NEUSE RIVER AND ESTUARY OF NORTH CAROLINA,

North Carolina Univ., Morehead City. Inst of Marine Sciences.
For primary bibliographic entry see Field 02L.
W70-02760

7C. Evaluation, Processing and Publication

FORTRAN-HYDRO,
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
Jacques W. Delleur, and Gerrit H. Toebes.
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6901, p 1993-2012, Nov 1969. 20 p, 10 fig, 2 tab, 7 ref, 4 append.

Descriptors: *Computer programs, *Data processing, *Hydrologic data, Open channel flow, Water resources, Digital computers, Groundwater movement, Hydraulics, Hydrology.
Identifiers: FORTRAN, ALGOL.

Computer programming, and particularly problem-oriented languages, useful in solving water resources engineering problems are reviewed. The original HYDRO language started by G. Bugliarello

and associates, was written in ALGOL. At present about 70 computation procedures are available, principally in hydrology, and hydraulic engineering. A FORTRAN adaptation of this language, called FORTRAN-HYDRO (FH), was developed. FH consists of a system of interlocking FORTRAN IV subroutines that may be strung or looped within a standard FORTRAN IV program. A library of 45 standard computation procedures in Hydrology and in Open Channel Hydraulics is available, and is expected to be extended. FH may be implemented on any computer having a FORTRAN compiler, an internal memory of at least 32K, and a fast access auxiliary memory. It has been found useful for teaching hydrology, hydraulics and water resources engineering. Some further work may make it of value to the practitioner as well. Methods of extending the library of subroutines as well as ways of contributing to it are suggested. (Knapp-USGS)
W70-02453

OPEN-CHANNEL SURGE SIMULATION BY DIGITAL COMPUTER,

Georgia Inst. of Tech., Atlanta. School of Engineering, and Harza Engineering Co., Chicago, Ill. Dept. of Hydraulics.
For primary bibliographic entry see Field 08B.
W70-02459

AN INVESTIGATION OF FLOODS IN HAWAII THROUGH SEPTEMBER 30, 1968,

Geological Survey, Honolulu, Hawaii.
R. Lee, and K. H. Fowler.
Geol Surv Basic Data Prog Rep No 11, June 1969. 170 p, 5 fig, 1 tab.

Descriptors: *Floods, *Hawaii, *Hydrologic data, *Data collections, Streamflow, Stage-discharge relations, Gaging stations, Stream gages.
Identifiers: *Flood records (Hawaii).

Records are compiled of annual peak stage and discharge at gaging stations in Hawaii through 1968. Each record consists of station name, description, location, drainage area, gage type, and maximum stage, maximum discharge, and date of maximum discharge for each water year of record. Gage locations are shown by maps. (Knapp-USGS)
W70-02471

FREQUENCY ANALYSIS OF RAINFALL INTENSITIES FOR CALCUTTA,

All-India Inst. of Hygiene and Public Health, Calcutta; and Calcutta Metropolitan Planning Organization (India).
For primary bibliographic entry see Field 02B.
W70-02634

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUADRANGLES, MISSISSIPPI-ALABAMA,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-407, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, *Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.

Identifiers: *Hurricane Camille (1969), Kreole (Miss), Grand Bay (Ala), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Kreole and Grand Bay, SW quadrangles show flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye

Field 07—RESOURCES DATA

Group 7C—Evaluation, Processing and Publication

of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 26 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02660

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BAY ST. LOUIS QUADRANGLE, MISSISSIPPI, Geological Survey, Washington, D.C.

K. V. Wilson, and James W. Hudson.

Geol Surv Hydrol Invest Atlas HA-400, 1 sheet, 1969. Text, 2 fig, 1 photo, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, *Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.

Identifiers: *Hurricane Camille (1969), Bay St. Louis (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Bay St. Louis quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02661

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NW QUADRANGLE, MISSISSIPPI, Geological Survey, Washington, D.C.

K. V. Wilson, and James W. Hudson.

Geol Surv Hydrol Invest Atlas HA-401, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, *Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.

Identifiers: *Hurricane Camille (1969), Gulfport (Miss), Tidal floods, Storm tides.

The area flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Gulfport NW quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02662

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASS CHRISTIAN QUADRANGLE, MISSISSIPPI, Geological Survey, Washington, D.C.

K. V. Wilson, and James W. Hudson.

Geol Surv Hydrol Invest Atlas HA-402, 1 sheet, 1969. Text, 2 fig, 1 photo, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.

Identifiers: *Hurricane Camille (1969), Pass Christian (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Pass Christian quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02663

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NORTH-SOUTH QUADRANGLES, MISSISSIPPI, Geological Survey, Washington, D.C.

K. V. Wilson, and James W. Hudson.

Geol Surv Hydrol Invest Atlas HA-403, 1 sheet, 1969. Text, 2 fig, 2 photo, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.

Identifiers: *Hurricane Camille (1969), Gulfport (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Gulfport N and S quadrangles show flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02666

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, VIDALIA QUADRANGLE, MISSISSIPPI, Geological Survey, Washington, D.C.

K. V. Wilson, and James W. Hudson.

Geol Surv Hydrol Invest Atlas HA-399, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, *Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.

Identifiers: *Hurricane Camille (1969), Vidalia (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The

Atlas of the Vidalia quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02665

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, WAVELAND-GRAND ISLAND PASS QUADRANGLES, MISSISSIPPI, Geological Survey, Washington, D.C.

K. V. Wilson, and James W. Hudson.

Geol Surv Hydrol Invest Atlas HA-398, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, *Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.

Identifiers: *Hurricane Camille (1969), Waveland (Miss), Grand Island Pass (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Waveland and Grand Island Pass quadrangles show flooded areas of a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02666

BEDLOAD FORMULAS,

Pennsylvania State Univ., University Park, Coll. of Engineering.

For primary bibliographic entry see Field 02J.

W70-02671

STOCHASTIC BASIS FOR COMPREHENSIVE RIVER BASIN PLANNING: PHASE I, Union Coll., Schenectady, N.Y. Water Resources Research Group.

For primary bibliographic entry see Field 06A.

W70-02681

08. ENGINEERING WORKS

8A. Structures

CONSTRUCTION OF THE KRASNOYARSK RESERVOIR AND ITS SHORE DEVELOPMENT (RUSSIAN), V. M. Shirokov.

In: Vodnye Resursy i Vodnoe Khozyaystvo Sibiri (Water Resources and Water Economy of Siberia), Akad Nauk SSSR, Sibirskoye Otdelenie, Geogr Obschestvo, Novosibirsk, USSR, p 9-16, 1968, 8 p, 1 fig, 1 tab, 5 ref.

Descriptors: *Water resources development, *Reservoir construction, *Reservoir operation.

*Bank stability, Shores, Water storage, Topography, Talus, Sediments, Floods, Frequency, Water levels.

Identifiers: *USSR, Krasnoyarsk Reservoir.

The dimensions and capacity of the proposed Krasnoyarsk reservoir of the Yenisei River are described and some forecasting pertaining to the development of its shoreline is given. The basic characteristics of this reservoir are as follows: the volume is 30 cubic kilometers, the area is 2100 square kilometers, the normal reservoir level is 243.0 m, and the level of 0.01% frequency flood is 244.2 m. It is believed that the presence of various types of rock outcrops in the reservoir areas and their topographical variations will considerably interfere with the formation of new shore slopes and shorelines. (Gabriel-USGS)
W70-02480

THE MAJARDAH SCHEME,
Long Island Univ., Greenvale, N.Y. C. W. Post Coll.
For primary bibliographic entry see Field 03F.
W70-02560

VIGILANCE OVER RESERVOIRS,
Gruner Brothers, Basle (Switzerland).
For primary bibliographic entry see Field 06E.
W70-02639

REVETMENTS FOR BANK PROTECTION USING VERY ROUGH-SURFACED FERRO-CONCRETE ELEMENTS (FRENCH),
Institut d'Aménagement et d'Economie de l'Eau, Warsaw (Poland).
M. M. Zajbert.

Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Sect 1, Subj 6, Inland Navigation, p 139-156, Paris, 1969. 18 p, 15 fig.

Descriptors: *Retaining walls, *Construction, *Slabs, Navigable waters, Water pressure.

Pre-fabricated reinforced concrete slabs with parallel ribs have been developed to reduce wave height. The influence of the height, spacing and form of the ribs has been determined. The reduction in wave breaking height increases rapidly with the height of the ribs. The ribbed slab permits an economy in the use of concrete. Empirical formulae determine the dimensions at which the slab will be sufficiently resistant to pressure. The principal applications of this process in Poland are described. The article is written in French and includes an English summary. (Grossman-Rutgers)
W70-02696

SHORE EROSION AND PROTECTION ST. LAWRENCE RIVER-CANADA,
Department of Public Works (Canada).
C. K. Hurst, and Dr. A. Brebner.

Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Sect 1, Sub 6, Inland Navigation, p 45-56, Paris, 1969. 12 p, 16 fig, 1 tab.

Descriptors: *Bank erosion, Costs, Federal government, Local government, Navigation.
Identifiers: *Saint-Lawrence River.

With the increase in ocean traffic on the St. Lawrence and the parallel increase of industries and population along its banks, the problem of bank protection has become important. The costs of protecting the banks are borne by the governments. The Federal government bears the costs of erosion of the banks due to shipping; the local authorities pay the costs that result from natural erosion, effects of the current, and waves caused by wind or ice. The main cause of bank erosion is the passage of shipping. Measurements along the river indicate that the height of the waves and the lowering of the water level caused by shipping depend upon the velocity of the ships and the width of the channels. For rivers having a width under 2,000

feet, navigation is the main cause of bank erosion. For widths over 4,000 feet the effect of navigation on the banks is negligible. Arrangements on the distribution of expenditure have been made. The article is written in English and contains a French summary. (Grossman-Rutgers)
W70-02697

HISTORICAL, FIELD AND EXPERIMENTAL STUDIES OF THE SUEZ CANAL BANK PROTECTION,

Suez Canal Authority Research Center, Ismailia (Egypt); and International Commission for Irrigation and Drainage.

Dr. Eng. A. A. Ammar.

Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Sect 1, Subj 6, Inland Navigation, p 199-213, Paris, 1969. 15 p, 10 fig, 2 tab, 7 ref.

Descriptors: *Retaining walls, *Costs, Grading, Bank stability, Asphalt.

Identifiers: *Traffic capacity, Synthetic fabrics.

The objective is to protect at the lowest cost the banks of the canal against erosion caused by the return current and by the waves made by shipping. The paper describes the evolution of measures taken over the years to cope with increasing traffic. Tests have been carried out on the use of new materials: asphalt and synthetic fabrics. The choice of the type of revetment to be used should spring from a technical and economic study which takes into account the construction, maintenance and working costs of the navigable waterway, and also the working costs of the vessels using the waterway. The article is written in English and includes a French summary. (Grossman-Rutgers)
W70-02698

METHODS OF BANK PROTECTION FOR PORT, INLAND WATER-WAY AND RIVER,

Toa Harbour Works Co. Ltd., Tokyo (Japan). Engineering Dept.

Akira Katayama.

Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Sect 1, Subj 6, Inland Navigation, p 87-108, Paris, 1969. 2 p, 17 fig, 5 photo, 3 tab.

Descriptors: *Retaining walls, Navigable waters, Costs, Construction materials.

Identifiers: *Flexible mattress.

A recently developed method to avoid undermining of coastal or river bank structures is explained. This method consists in covering the foundation with a mattress made up of a series of synthetic material sacks filled with sand. This mattress is flexible and it adapts itself to foundation soil movements. The choice of synthetic material used must resist friction and ultra-violet rays. Several examples of the use of this method are given. The main features of this method are its rapidity of construction and low cost. The article is written in English and includes a French summary. (Grossman-Rutgers)
W70-02699

A STUDY OF FLOW CONDITIONS IN SHAFT SPILLWAYS,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.

Yusuf G. Mussalli, and M. R. Carstens.

Available from the Clearinghouse as PB-188 909, \$3.00 in paper copy, \$0.65 in microfiche. Water Resources Center, Georgia Institute of Technology, Report WRC-0669, Sept 1969. 158 p, 4 tab, 68 fig, 56 ref. OWRR Project B-022-GA.

Descriptors: *Spillways, *Vertical conduits, *Horizontal conduits, *Closed-conduit flow, *Closed conduits, *Flow control, *Weirs, Aeration, Air demand, Critical flow, Outlets, Turbulent flow, Aerated flow, Air entrainment, Weir control, Identifiers: *Vertical shaft spillways, *Inclined-shaft spillways.

The purpose of the study was to develop data for design of vertical-and inclined-shaft spillways. A vertical shaft 4 inches square connected to a horizontal conduit by a 90-degree circular bend was used in the experiments. Studies were conducted using bend configurations of 3 different radii and various deflectors and with varying amounts of air admitted to the vertical shaft. The research demonstrates clearly the role of the bend curvature, deflector and air concentration on the phenomenon of sealing or transition to pipe control in the horizontal conduit. Sealing of the horizontal conduit depends on the Froude number of the flow. To maintain partly-full flow in the horizontal conduit, more air space is needed above the water flow area with an increase in Froude number. The water-flow area in the horizontal conduit with short-tube control is determined by the ratio of the radius of curvature along the centerline to the bend diameter and the deflector thickness at the crown. Ventilation of the horizontal conduit delays sealing and aeration of the water flow hastens sealing. With weir control, waves on the flow surface hasten sealing and highly aerated flow delays sealing. Ratios of radius of curvature along the centerline to the bend diameter larger than 2.0 are recommended, as bends of larger ratios generate less waves. (Conway-Georgia Tech)
W70-02774

COUNTY'S RIGHT OF ENTRY FOR CONSTRUCTION.

For primary bibliographic entry see Field 06E.
W70-02825

8B. Hydraulics

TRIANGULAR BROAD-CRESTED WEIR,

Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins. For primary bibliographic entry see Field 07B.
W70-02449

EFFECT OF INTAKE ELEVATION AND OPERATION ON WATER TEMPERATURE.

Tennessee Valley Authority, Norris.
Walter O. Wunderlich, and Rex A. Elder.
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6917, p 2081-2091, Nov 1969. 11 p, 9 fig, 11 ref.

Descriptors: *Water temperature, *Reservoir operation, Stratification, Water resources development, Planning, Reservoir design, Water management (Applied), Water quality, Water quality control, Flood control, Simulation analysis, Thermodynamics.

Identifiers: Water temperature control, Reservoir thermodynamics.

A graphical temperature prediction method based on simplifying assumptions is used to demonstrate how intake elevation and operation at certain times of the year influence outflow water temperature during a yearly cycle of temperature stratification buildup and decay. Temperature predictions are made for 3 different intake elevations and 3 different years in which the hydrologic conditions require different reservoir operations. The method illustrates how intake elevation, reservoir operation and geometry, surface or bottom intake operation, inflow quantity and its annual distribution, inflow temperature, water surface elevation and climate influence outflow temperature. Additional applications are made to an existing reservoir to simulate a known operation and to check the reliability of the method. For the same reservoir, the outflow temperature of an assumed drastic operation change is predicted. The results show that dependent upon the combination of all factors, one and the same reservoir can produce a great variety of temperature patterns. (Knapp-USGS)
W70-02456

Field 08—ENGINEERING WORKS

Group 8B—Hydraulics

FLUCTUATING PRESSURES IN SPILLWAY STILLING BASINS.

Minnesota Univ., Minneapolis. Dept. of Civil Engineering; and Iowa State Univ., Ames. Dept. of Engineering Mechanics.

C. Edward Bowers, and Frank Y. Tsai.

ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6915, p 2071-2079, Nov 1969. 9 p, 9 fig, 6 ref.

Descriptors: *Stilling basins, *Unsteady flow, *Hydraulic models, *Hydraulic jump, Turbulence, Vortices, Open channel flow, Spillways, Energy dissipation, Flow, Surges, Laboratory tests, Model studies.

Identifiers: *Stilling-basin pressure fluctuations.

Experimental data are presented on fluctuating pressures in models of spillway stilling basins. Of special interest are data on (1) variation of pressure fluctuations with location in the basin, (2) variation of fluctuations with discharge, and (3) the growth of a pressure pulse as flow passes through the upstream portion of the hydraulic jump. Pressure fluctuations up to plus or minus 40% of the incident-velocity head were measured during the tests. (Knapp-USGS)

W70-02457

OPEN-CHANNEL SURGE SIMULATION BY DIGITAL COMPUTER,

Georgia Inst. of Tech., Atlanta. School of Engineering, and Harza Engineering Co., Chicago, Ill. Dept. of Hydraulics.

C. Samuel Martin, and Frank G. DeFazio.

ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6911, p 2049-2070, Nov 1969. 22 p, 23 fig, 1 tab, 12 ref, append.

Descriptors: *Open channel flow, *Surges, *Simulation analysis, Digital computers, Computer models, Hydraulics, Numerical analysis, Open channels, Waves (Water), Closed conduit flow, Hydrograph analysis, Unsteady flow.

Identifiers: Open channel surges.

The equations of motion for unsteady gradually-varied flow in open channels are expressed in a finite-difference form suitable for programming on a high-speed digital computer. The staggered-net scheme introduced by Stoker is expanded to be applicable to a system of N interconnected channels, with each of their ends subject to one of the following boundary conditions: discharge hydrograph, stage hydrograph, stage-discharge relationship, dead end or junction of channels. The theory and computer program are tested and compared with existing experimental results corresponding to the following situations: (1) Flood hydrograph in circular channel; (2) power-load rejection in headrace of trapezoidal canal; (3) power-load acceptance in tailrace of rectangular model channel; and (4) tidal (stage hydrograph) in rectangular model estuary. Because of good correlation between simulated and experimental results in all four instances and the ease of coding various problems, the staggered scheme of Stoker is strongly recommended for practicing engineers. (Knapp-USGS)

W70-02459

LOCAL SCOUR AROUND BRIDGE PIERS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

H. W. Shen, V. R. Schneider, and S. Karaki.

ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6891, p 1919-1940, Nov 1969. 22 p, 12 fig, 1 tab, 32 ref, append.

Descriptors: *Scour, *Piers, Erosion, Stream erosion, Vortices, Turbulence, Eddies, Hydraulics, Sediment transport, Open channel flow, Steady flow, Bed load.

Identifiers: Bridge pier scour.

Local scour caused by the horseshoe vortex system which forms at the base of the piers is considered. Piers which induce a pressure field strong enough to cause the formulation of the horseshoe vortex

system are termed 'blunt nosed'; all others being classed as sharp-nosed piers. The condition of the sediment transported into and out of the scour hole forms the basis for the further classification of the scour process into clear-water scour and scour with continuous sediment motion. The pier Reynolds number is shown to be an important variable describing the strength of the horseshoe vortex system. Further, the equilibrium scour depth depends on the initial sediment transport condition for a steady uniform flow with fully developed bed material transport. Design criteria are proposed for blunt-nosed piers under the conditions of clear-water scour and scour with continuous sediment motion. Several deviations from the above ideal design conditions are discussed; methods for design in these cases are suggested. (Knapp-USGS)

W70-02462

COORDINATION IN MOBILE-BED HYDRAULICS,

Alberta Univ., Edmonton. Dept. of Civil Engineering.

Thomas Blench.

ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6884, p 1871-1898, Nov 1969. 28 p, 9 fig, 31 ref, append.

Descriptors: *Sediment transport, *Alluvial channels, *Open channel flow, *Mathematical models, Bed load, Hydraulics, Streamflow, Model studies, Reviews, Research and development, Mathematical studies, Hydraulic models.

Identifiers: Mobile-bed hydraulics, Channel stabilization.

A mathematical study was made of bed-load transport in flumes, and two independent seven-dimensional functional relations among 'numerics' are established. The procedure was analogous to, but more complex than, producing the friction-factor diagram plot for Newtonian flow in uniform circular pipes. It is used to analyze the self-adjustment of natural channels and the transport of bed load in flumes. Different formulations are necessary to represent different flow, with transport phases advertised by different bed forms. Features of world data become apparent. Coordination of legitimately divergent formulas is seen to be necessary for an overall picture of the phenomena. Recommendations are made for improved cooperative international research covering the practically important range of independent variables. (Knapp-USGS)

W70-02463

NONLINEAR FLOW IN POROUS MEDIA,

Missouri Univ., Rolla. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

For primary bibliographic entry see Field 02F.
W70-02464

MOVEMENT OF SAND IN TUNNELS,

Norges Tekniske Hoegskole, Trondheim. River and Harbor Lab.

Dagfinn K. Lysne.

ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6880, p 1835-1846, Nov 1969. 12 p, 6 fig, 2 tab, 9 ref, append.

Descriptors: *Sediment transport, *Closed conduit flow, *Model studies, Erosion, Open channel flow, Hydraulic models, Particle size, Particle shape, Turbulence, Sands, Gravels, Tunnels.

Identifiers: Tunnel sediment transport.

The movement of sand and finely crushed rock in tunnels is investigated. A basic assumption is that the amount of transported material per unit time is low. Two problems have been distinguished and dealt with: (1) The general aspect of sand movement in a horizontal tunnel and; (2) the conditions for uniform sand movement in tunnels with variable slope. An analysis, based on present information of erosion in open channels, leads to equations for (1) calculating limiting size of particles being

moved; and (2) the variation of cross section necessary to maintain uniform sand transport in long tunnels with variable slope. Coefficients are determined on the basis of laboratory tests and field data. (Knapp-USGS)

W70-02465

THE INTERPRETATION OF INTERFERENCE TESTS IN NATURALLY FRACTURED RESERVOIRS WITH UNIFORM FRACTURE DISTRIBUTION,

Atlantic Richfield Co., Dallas, Tex.

H. Kazemi, M. S. Seth, and G. W. Thomas.

Society of Petroleum Engineers Journal, Vol 9, No 4, p 463-472, Dec 1969. 10 p, 2 fig, 18 ref, 2 append.

Descriptors: *Drawdown, *Flow, *Mathematical models, *Porous media, *Permeability, Fractures (Geology), Pores, Transmissivity, Pumping, Well spacing, Withdrawal.

Identifiers: Double-porosity drawdown calculation, Interference tests.

The double-porosity model of Warren and Root for examining pressure drawdown and buildup phenomena in naturally fractured reservoirs has been extended to interpret interference test results. Both analytical and numerical solutions are presented. The practicality of some of the assumptions in the Warren-Root model was also investigated. The effects of well spacing and the magnitude of the interporosity flow parameter are briefly discussed. Another procedure for interpreting interference tests in naturally fractured reservoirs employs an equivalent homogeneous reservoir model, which is inadequate for early time responses, but for late time responses it yields favorable results. (Knapp-USGS)

W70-02469

AN INVESTIGATION OF THE FLOW REGIME FOR HELE-SHAW FLOW,

Shell Development Co., Houston, Tex.; and Purdue Univ., Lafayette, Ind.

R. C. Smith, and R. A. Greenkorn.

Society of Petroleum Engineers Journal, Vol 9, No 4, p 434-442, Dec 1969. 9 p, 7 fig, 7 ref, append. Grant No 1797-A2, (Amer Chem Soc-Petrol Res Fund).

Descriptors: *Flow, *Porous media, *Darcy's law, *Hydraulic models, Mathematical studies, Reynolds number, Model studies, Laboratory tests, Steady flow, Groundwater movement.

Identifiers: *Hele-Shaw models.

Hele-Shaw cells are used to model creeping flow through porous media (where Darcy's law is valid). The effects of inertia on flow about obstructions in a Hele-Shaw cell can be calculated by a perturbation method by determining a solution to Laplace's equation. Results of a computer solution for flow about circular, square and elliptical obstructions are presented. For a modified Reynolds number of less than 1, the inertia terms are small, and for values of less than 3, the average streamline predicts the ideal flow. The analogy should be useful for studying flow in porous media up to a modified Reynolds number of at least 3. (Knapp-USGS)

W70-02470

FLOW BELOW DEEPLY SUBMERGED RECTANGULAR WEIRS,

Alberta Univ., Edmonton. Dept. of Civil Engineering.

For primary bibliographic entry see Field 02E.
W70-02472

AIR ENTRAINMENT BY FLOWING WATER UNDER REDUCED ATMOSPHERIC PRESSURE,

Engineering Labs., Cambridge (England).

For primary bibliographic entry see Field 02E.
W70-02474

JETS WITH NEGATIVE BUOYANCY IN HOMOGENEOUS FLUID,
Waterloopkundig Laboratorium, Delft (Netherlands).
For primary bibliographic entry see Field 02E.
W70-02715

A HYDRAULIC MODEL STUDY OF HEAT DISSIPATION AT KINCARDINE POWER STATION,
Williamson (James) and Partners, Glasgow (Scotland).
For primary bibliographic entry see Field 05B.
W70-02717

8C. Hydraulic Machinery

PLANNING FOR POWER - A LOOK AT TOMORROW'S STATION SIZES,
Ebasco Services, Inc.

R. R. Bennett.
IEEE Spectrum, Vol 6 (9), p 67-72, 1968. 4 fig.

Identifiers: *Electrical system design, *Power growth surveys, *Systems engineering, *Turbine-generators, Air pollution, Boiling-water reactors, Cooling towers, Fossil fuels, Reactor siting, Single-purpose plant, Breeder reactors.

Predictions of the sizes of electric power generating stations for the year 1987 were made by superimposing the effects of availability of cooling water, availability of fuel, environmental limitations, electric system limitations, component design, manufacture, and shipment limitations, and land requirements on projections of the historical trends in load growth, unit size, and station size. U.S. peak electrical loads increased from 60,000 MW (E) to 225,000 MW (E) between 1947 and 1967 and are estimated to increase to 900,000 MW (E) in 1987. The average unit size increased from 38 MW (E) in 1947 to 280 MW (E) in 1967, the largest unit size increased from 100 MW (E) to 1000 MW (E), the average station size increased from 34 MW (E) to 200 MW (E), and the largest station size increased from 880 MW (E) to 1950 MW (E). For the year 1987 the largest unit size is predicted to be 3000 MW (E) and the largest station size 12,000 MW (E), the average unit size is predicted to be 1500 MW (E) and the average station size 4000 MW (E).

W70-02740

DESIGN OF A COMBINED SEWER FLUIDIC REGULATOR, THE DEVELOPMENT OF BASIC CONFIGURATIONS AND DESIGN CRITERIA FOR APPLICATIONS OF FLUIDS IN SEWER REGULATORS.

Bowles Engineering Corp., Silver Spring, Md.
For primary bibliographic entry see Field 04A.
W70-02773

8E. Rock Mechanics and Geology

OOLITIC ARAGONITE AND QUARTZ SAND: LABORATORY COMPARISON UNDER WAVE ACTION,
Army Coastal Engineering Research Center, Washington, D.C.
Frederick F. Monroe.

Available without charge from US Army Coastal Engineering Research Center, 5201 Little Falls Road, N.W., Washington, DC, 20016. Corps Engineers Coastal Engineering Research Center Miscellaneous Paper No 1-69, Apr 1969. 84 p, 58 fig, 5 tab, 7 ref, 3 append.

Descriptors: *Quartz, *Sands, *Carbonate rocks, *Sediments, *Erosion, *Laboratory tests, Waves (Water), Particle size, Beaches, Beach erosion, Coastal engineering, Test procedures, Fluorescence, Cost comparisons.
Identifiers: *Oolitic aragonite, Quartz sand, Beach nourishment.

The use of oolitic aragonite as a suitable beach fill material was investigated in laboratory tests and field studies. Results of the field study proved inconclusive but the laboratory tests show oolitic aragonite to be a suitable material hydraulically for beach nourishment if it can be placed on the beach at a cost competitive with other sand sources, and if the energy environment of the beach does not require a larger size material than in the oolitic aragonite. Detailed description of analytical procedures and many curves depicting the results of the studies are given. (Gabriel-USGS)
W70-02624

INVESTIGATION OF SOIL FREEZING,
Rhode Island Univ., Kingston. Dept. of Civil Engineering.

Wang Mian Chang.
PB-188 907. Technical Completion Report, Rhode Island Water Resources Center, 1969. 51 p, 1 tab, 28 fig, 19 ref. OWRR Project A-023-RI.

Descriptors: *Frost action, *Heave, Heat flow, Moisture migration, *Compacted soils.

Identifiers: *Soil freezing.

Study on the effect of some important factors on such frost behaviors of compacted soils as the rate and depth of frost penetration, water content increase and frost heaving is described. The factors investigated are the degree of saturation, molding water content, dry density and soil textures. The apparatus used included a cold chest, a reflecting type galvanometer and copper-constantan thermocouples, a set of one thousandth inch dial gages and an X-ray machine. The experimental results show that increasing initial degree of saturation (for a constant dry density), decreasing dry density (for a constant degree of saturation), and decreasing the percentage of fine grain (0.002 mm.) content will decrease the rate of frost penetration, and that decreasing initial degree of saturation, increasing dry density and the percentage of fine grain content will decrease overall frost heaving. Frost heaving of soils compacted using a constant compaction effort, however, increases with increasing molding moisture content regardless of the change of dry density.
W70-02750

DYNAMIC BEHAVIOR OF SOIL,

Rhode Island Univ., Kingston. Dept. of Civil Engineering; and Rhode Island Univ., Kingston. Dept. of Ocean Engineering.

Vito A. Nacci.
PB-188 904. Technical Completion Report, Rhode Island Water Resources Center, 1969. 45 p, 23 fig, 38 ref. OWRR Project A-016-RI.

Descriptors: *Elastic wave propagation, *Shear modulus, *Silt.

Identifiers: Anisotropy, *Stress-strain.

Investigation concerning the dynamic shear modulus of silt sedimented at different degrees of anisotropy are described. The influence of confining pressure and amplitude of vibration on the shear modulus was investigated. The resonant column method under fully saturated conditions was used to study the effects of the various parameters. The results show that the shear modulus of normally consolidated silt varies as the 7/10th power of the confining pressure. The modulus is also greatly influenced by strata orientation and void ratio. At relatively small amplitudes of vibration, less than 10-5 radians, the shear modulus is constant and can be considered to be the elastic dynamic shear modulus of the soil.
W70-02751

8F. Concrete

REVETMENTS FOR BANK PROTECTION USING VERY ROUGH-SURFACED FERRO-CONCRETE ELEMENTS (FRENCH),
Institut d'Aménagement et d'Economie de l'Eau, Warsaw (Poland).

For primary bibliographic entry see Field 08A.
W70-02696

SHORE EROSION AND PROTECTION ST. LAWRENCE RIVER-CANADA,
Department of Public Works (Canada).
For primary bibliographic entry see Field 08A.
W70-02697

8G. Materials

SIMULTANEOUS DETERMINATION OF BASIC GEOMETRICAL CHARACTERISTICS OF POROUS MEDIA,

Instituto Mexicano del Petroleo, Mexico.
Candelario Perez-Rosales.

Society of Petroleum Engineers Journal, Vol 9, No 4, p 413-416, Dec 1969. 4 p, 3 fig, 3 ref.

Descriptors: *Porous media, *Porosity, *Particle size, *Particle shape, *Permeability, Analytical techniques, Interstices, Pores, Void ratio, Voids, Laboratory tests.

Identifiers: Pore geometry.

A statistical method for determining simultaneously some of the basic geometrical characteristics of porous media such as porosity, specific surface, mean pore width, mean grain thickness and absolute permeability is presented. The proposed method is characterized by its simplicity and the minimum amount of laboratory equipment that it requires. The experimental procedure used is based upon the surface analysis of a sample. In view of this fact the applicability of the method is limited to homogeneous and isotropic materials. (Knapp-USGS)
W70-02466

SALT WATER CORROSION CONTROL BY ENVIRONMENT MODIFICATION,

Dow Chemical Co., Freeport, Tex. Texas Div.
Robert A. Legault.

Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for \$1.25 per copy. Office of Saline Water, Research and Development Progress Report No 438, Apr 1969. 116 p. OSW Contract 14-01-0001-1482.

Descriptors: *Corrosion control, *Inhibitors, *Desalination, *Deaeration, Water-treatment.
Identifiers: *Dissolved-oxygen, Pitting, Chromates, Phosphates.

This study was concerned with corrosion control through environment modification without regard to the possible contamination of product water or the possible production of a toxic desalination plant effluent by an additive. If a particular additive performs satisfactorily as a corrosion inhibitor, the elimination of any contamination can be studied as a separate problem. The efficient exclusion of dissolved oxygen from sea water will permit the use of mild steel in this environment at a temperature of 250 deg F. Contamination of the sea water with traces of dissolved oxygen is sufficient to cause a localized attack that is prohibitive even at low corrosion rate values. Additionally, data obtained in this program indicate that: 5052 aluminum can be used without additives in desalination applications, and the presence of dissolved oxygen is not detrimental; the addition of 50 ppm of a binary phosphate-chromate inhibitor to the sea water makes it possible to use mild steel in desalination environments containing dissolved oxygen; the addition of 50 ppm of bicarbonate ion to the sea water makes it possible to use 1100 aluminum in desalination applications when the pH is adequately controlled; the addition of 100 ppm of chromate ion to the sea water makes it possible to use 1100 aluminum, as well as 3003, 5554, and 6061 aluminum, in desalination applications. (Filban-Office of Saline Water)
W70-02689

Field 08—ENGINEERING WORKS

Group 8G—Materials

ULTRASONIC DETECTION OF CALCIUM SULFATE SCALE ON METAL SURFACES, Midwest Research Inst., Kansas City, Mo.

Fred R. Rollins, Jr.

Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for \$0.50 per copy. Office of Saline Water, Research and Development Progress Report No 444, June 1969. 39 p. OSW Contract 14-01-0001-1718.

Descriptors: *Scaling, *Calcium sulfate, *Ultrasonics, Heat transfer.

Identifiers: *Scale deposition, *Ultrasonic detection.

A study of ultrasonic reflectivity at liquid-metal interfaces where CaSO_4 scale is also present has led to a technique which should be very useful for fixed-station scale detection in saline water conversion plants. The technique utilizes small high-temperature transducers that can be soldered directly to the outside surface of heat-transfer tubes. The geometry is such that the ultrasonic beam produced by these transducers converges to a focal point along the center line of the heat-transfer tube, and then diverges to strike the opposite wall at normal incidence. With suitable electronic gear, the system provides nearly exponentially decaying echo trains at frequencies from a few megahertz up to 20 MHz. These echo trains remain remarkably stable at water temperatures as high as 280 deg F and flow velocities of 3 ft/sec. The decay rate of the echo train is strongly affected by the presence of scale on the inside surfaces of the heat transfer tube. The sensitivity of the technique for scale detection increases with increased frequency; but other problems, such as attenuation by the water, ultimately set an upper limit on a practical frequency. The decay rate also depends on the exact nature of the scale. For this reason, the current program did not establish an exact calibration, but the technique appears to be completely capable of detecting deposits with thicknesses of 1 mil or more. Further study and development should set a lower limit for detection of well below 1 mil. (Filban-Office of Saline Water)

W70-02690

SEA WATER CORROSION TEST PROGRAM, Dow Chemical Company, Freeport, Tex. O. Osborn, L. Rice, W. B. Russell, C. F. Schrieber, and J. C. Williams.

Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for \$1.25 per copy. Office of Saline Water, Research and Development Progress Report No 417, Mar 1969. 108 p. OSW Contract 14-01-0001-1090.

Descriptors: *Copper alloys, *Dissolved oxygen, *Deaeration, Corrosion, Pitting, Dissolved oxygen analyzers.

Identifiers: Electrochemical corrosion rate, Weight-loss measurements, pH.

A small, highly automated pilot plant which could simulate most of the water conditions encountered in a distillation plant was constructed. Coupon weight losses of selected metals were then determined under the variables of dissolved oxygen concentration, pH, temperature, velocity, and water replenishment rate. The program thus far has progressed through the copper alloy family of 90-10 CuNi (706), 70-30 CuNi (715), 60-40 CuNi (720), Aluminum Brass (687), Ars. Admiralty Brass (443), and Phos. Deoxidized Copper (122). All alloys show extremely low weight loss under low dissolved oxygen conditions. (Filban-Office of Saline Water)

W70-02691

EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION, TRW Systems Group, Redondo Beach, Calif. B. D. Marcus, H. P. Silverman, and W. T. Tsukamoto.

Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for \$0.70 per copy. Office of Saline Water, Research and Development Progress Report No 393, Jan 1969. 79 p. OSW Contract 14-01-0001-1447.

Descriptors: *Scaling, *Calcium sulfate, *Heat transfer, *Distillation desalination.

Identifiers: *Heat exchange surfaces, *Nucleation site, *Crystal growth, Radioisotope technique.

An experimental program was performed to investigate the effect of surface potential on the formation of calcium sulfate scale on platinum electrodes. The earliest stages of scale formation (nucleation), involving very small deposits of CaSO_4 , were of primary interest. Consequently, extremely sensitive radioisotope techniques were used for the basic measurements. Supersaturated calcium sulfate solutions were prepared in a temperature-controlled vessel by mixing S35-labelled H_2SO_4 with a $\text{Ca}(\text{OH})_2$ slurry. Five clusters of five carefully prepared platinum electrodes (25 in all) were then immersed in this solution and held at various potentials for pre-determined periods of time. After immersion the electrodes were removed, rinsed of excess radioactive solution and dried. They were then counted for radioactivity (S35 decays by emission of a 0.167 MeV B-particle). The count rate was proportional to the total mass of CaSO_4 deposited on a given area of electrode. After counting them, the electrodes were autoradiographed yielding a map of the number and distribution of scale deposits on the surface. Results of multiple experiments were compared in order to achieve a sufficiently large body of data for statistical significance. It was demonstrated that surface potential is indeed a pertinent variable in scale formation. (Filban-Office of Saline Water)

W70-02692

DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER,

Westinghouse Electric Corp., Pittsburgh, Pa.

N. Pessall, F. C. Hull, and C. Liu.

Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for \$0.70 per copy. Office of Saline Water Research and Development Progress Report No 478, Sept 1969. 76 p. OSW Contract 14-01-0001-1828.

Descriptors: *Corrosion, *Pitting resistance, *Desalination, *Alloys, Metallurgy.

Identifiers: *Iron alloys, *Anodic polarization, Critical pitting potential, Multicomponent ferritic steel.

Iron-base alloys, ranging from binary alloys of Fe-Cr to multicomponent alloys based on Fe-Cr-Mo, have been prepared by levitation melting. The relative resistances of the alloys to pitting corrosion in deaerated synthetic sea water, at temperatures up to 250 deg F, have been evaluated on the basis of critical pitting potentials, Ecrit, obtained from anodic polarization measurements. Based on studies of synergistic interactions, the most promising ferritic steels for use in aqueous chloride environments have been found in the Fe-Cr-Mo-Co alloy system. A tentative correlation between Ecrit and d-shell character of the component elements of quaternary alloys based on Fe-Cr-Mo suggests that multi-component ferritic steels, containing Cr and Mo as major additives in combination with small concentrations of Mn, Co, Ni, and/or Cu, will have exceptionally high resistance to pitting attack in aqueous chloride media. (Filban-Office of Saline Water)

W70-02693

HISTORICAL, FIELD AND EXPERIMENTAL STUDIES OF THE SUEZ CANAL BANK PROTECTION,

Suez Canal Authority Research Center, Ismailia (Egypt); and International Commission for Irrigation and Drainage.

For primary bibliographic entry see Field 08A.
W70-02698

METHODS OF BANK PROTECTION FOR PORT, INLAND WATER-WAY AND RIVER, Toa Harbour Works Co. Ltd., Tokyo (Japan). Engineering Dept.

For primary bibliographic entry see Field 08A.
W70-02699

EVALUATION OF TITANIUM-PLATED STEEL IN A CHLORIDE ENVIRONMENT, Solar, San Diego, Calif.

R. V. Warnock, and A. R. Stetson.

Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 for \$0.70 per copy. Office of Saline Water, Research and Development Progress Report No 393, Jan 1969. 68 p. OSW Contract 14-01-0001-1441.

Descriptors: *Desalination, *Titanium, *Protective coatings, Pitting, Corrosion control.

Identifiers: *Titanium plating, *Plated low-carbon steels, *Fused salt plating, Electrolytic coating.

Deposition of titanium coatings on low-carbon steels was accomplished by both electrolytic and nonelectrolytic techniques. Two chemical systems ($\text{K}_2\text{TiF}_6\text{-NaF-LiF}$ and $\text{K}_2\text{TiF}_6\text{-KF-LiF}$) were investigated and a 5 mole percent KwTiF_6 -eutectic NaF-LiF bath was selected for coating the majority of corrosion test specimens. Nonelectrolytic coatings were deposited at 1700 deg F and electrolytic coatings were applied at 1550 deg F and 1.0 ampere/inch sq current density. The surface concentration of the 0.003-inch thick coatings was 95 percent or greater titanium and 5 percent or less iron. Boiling sea water, aerated, room temperature sea water, autoclave (280 deg F) and velocity effects corrosion tests showed the nonelectrolytic 0.003-inch thick coating to possess a corrosion resistance essentially equal to that of pure (A-70) titanium. The rate of coating deposition was found to be of prime importance in determining corrosion resistance because the deposition rate largely controls the coating composition (alloy versus intermetallic compound). (Filban-Office of Saline Water)

W70-02741

DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER,

Westinghouse Electric Corp., Pittsburgh, Pa.

N. Pessall, F. C. Hull, N. Michael, and C. Liu.

Available from the Superintendent of Documents, US Government Printing Office, Washington, DC, 20402, for \$0.75 per copy. Office of Saline Water, Research and Development Progress Report No 394, Jan 1969. 79 p. OSW Contract 14-01-0001-1447.

Descriptors: *Desalination, *Iron alloys, *Corrosion control, *Electrochemistry, Crystallography, Pitting.

Identifiers: *Iron-base alloys, *Anodic polarization, Critical potential, Passivation.

Iron-base alloys, ranging from binary alloys to multi-component alloys, containing as many as eleven different components have been prepared by levitation melting. Dynamic loop-tests at 250 deg F in deaerated sea water, as well as studies of anodic polarization curves carried out at room temperature in deaerated 0.1N NaCl solution, have been used to evaluate the relative corrosion behavior of the alloys. The investigations have indicated minimal effects of melting practice, processing procedure, and crystallographic texture on the corrosion of iron-base alloys in hot sea water. Based on the observation of synergistic alloying effects in Fe-Cr and Fe-Al alloys, future development of new corrosion resistant iron-base alloys is likely to be based on multi-component single phase alloys containing chromium and/or aluminum as major alloying components. Additions of

Co, Mo, Ni, Nb, Si, W, Ag, Zr, V, and Ti have all shown beneficial effects as alloying elements. A comparison of polarization measurements with loop-test data has indicated that, with certain precautions, the electrochemical method is to be preferred when evaluating new iron-base alloy compositions. (Filban-Office of Saline Water)
W70-02742

10. SCIENTIFIC AND TECHNICAL INFORMATION

RIVER ICE JAMS - A LITERATURE REVIEW,

United States Lake Survey, Detroit, Mich.

For primary bibliographic entry see Field 02C.
W70-02494

**COMBATING POLLUTION CREATED BY OIL
SPILLS, VOLUME I: METHODS,**
Little (Arthur D.), Inc., Cambridge, Mass.
For primary bibliographic entry see Field 05G.
W70-02744

SUBJECT INDEX

ACCLIMATIZATION		
DESERTS THE PROBLEM OF WATER IN ARID LANDS,	02A	
W70-02561		
ACID MINE WATER		
ALGAE IN RELATION TO MINE WATER,		
W70-02770	05C	
EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN		
ONTARIO LAKES,		
W70-02792	05C	
ACTIVATED CARBON		
INFLUENCE OF PH ON THE ABSORPTION OF AROMATIC ACIDS ON		
ACTIVATED CARBON,		
W70-02443	05G	
ACTIVATED SLUDGE		
STABILIZATION OF AN ACTIVATED SLUDGE PLANT,		
W70-02593	05D	
PHOSPHATE REMOVAL AT PORT WORTH, TEXAS,		
W70-02596	05D	
COMPACT ACTIVATED-SLUDGE TREATMENT OF COMBINED PETROCHEMICAL		
MUNICIPAL WASTE,		
W70-02600	05D	
KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION,		
W70-02611	05D	
ENERGY CONCEPTS OF AEROBIC MICROBIAL METABOLISM,		
W70-02613	05D	
ACTIVATED SLUDGE PROCESS		
ANALOG SIMULATION OF ACTIVATED SLUDGE SYSTEMS,		
W70-02608	05D	
ADMINISTRATION		
DEPARTMENT OF NATURAL RESOURCES.		
W70-02584	06E	
ADMINISTRATIVE AGENCIES		
FLOOD CONTROL.		
W70-02573	04A	
W70-02574	04A	
CONSERVATION OF NATURAL RESOURCES.		
W70-02587	03D	
FREE AND COMMON SHELLFISHERIES.		
W70-02590	06E	
TRANSFER OF POWERS.		
W70-02830	06E	
ADSORPTION		
AXIAL-DISPERSION CONSTANT-PATTERN KINETICS OF ION-EXCHANGE		
AND ADSORPTION COLUMNS,		
W70-02688	03A	
ADSORPTION PROCESSES		
AXIAL-DISPERSION CONSTANT-PATTERN KINETICS OF ION-EXCHANGE		
AND ADSORPTION COLUMNS,		
W70-02688	03A	
AERATION		
PHOSPHATE REMOVAL AT PORT WORTH, TEXAS,		
W70-02596	05D	
EXPERIMENTAL PROBLEMS ASSOCIATED WITH THE TESTING OF SURFACE		
AERATION EQUIPMENT,		
W70-02612	05D	
AERATORS		
PRELIMINARY DESIGN OF WASTEWATER TREATMENT SYSTEMS,		
W70-02610	05D	
AERO-ACCELERATOR		
COMPACT ACTIVATED-SLUDGE TREATMENT OF COMBINED PETROCHEMICAL		
MUNICIPAL WASTE,		
W70-02600	05D	
AFGHANISTAN		
HYDROGRAPHIC AND SEDIMENTATION SURVEY OF KAJAKAI RESERVOIR,		
AFGHANISTAN,		
W70-02669	02J	
AFRICA		
LIMITATION OF ALGAL GROWTH IN SOME CENTRAL AFRICAN WATERS,		
W70-02646	05C	
AGRICULTURAL DRAINAGE		
FERTILIZATION OF LAKES BY AGRICULTURAL AND URBAN DRAINAGE,		
W70-02787	05B	
AGRICULTURAL PROCESSING PLANTS		
THE MAJARDAH SCHEME,		
W70-02560	03F	
AGRICULTURAL WATERSHEDS		
FERTILIZATION OF LAKES BY AGRICULTURAL AND URBAN DRAINAGE,		
W70-02787	05B	
AGRICULTURE		
THE MAJARDAH SCHEME,		

1

SUBJECT INDEX

ALU-ART		
ALUMINUM WIRDS REMOVAL BY CHEMICAL COAGULATION, W70-02767	05F	ORGANIC MATTER IN FRESH WATER, W70-02769
AMMONIA PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONCHARTRAIN, LOUISIANA, W70-02766	05C	AQUATIC PLANTS CONSERVATION AND CONTROL OF AQUATIC PLANTS AND FISH, W70-02838
ANAEROBIC ANAEROBIC DIGESTION I. THE MICROBIOLOGY OF ANAEROBIC DIGESTION (REVIEW PAPER), W70-02603	05D	04A AQUEOUS SOLUTIONS THERMODYNAMIC MIXING PROPERTIES OF NaCl LIQUIDS, W70-02627
ANAEROBIC DIGESTION FACTOR ANALYSIS AS AN AID IN AN ECOLOGICAL STUDY OF ANAEROBIC DIGESTION, W70-02594	05D	02K AQUIFERS SALT-WATER ENCROACHMENT INTO AQUIFERS, W70-02484
THE EFFECT OF METHANE ANALOGUES ON METHANOGENESIS IN ANAEROBIC DIGESTION, W70-02595	05D	02L COMBATING SALT-WATER ENCROACHMENT INTO THE BISCAYNE AQUIFER OF MIAMI, FLORIDA, W70-02485
THE METHANE FERMENTATION BETWEEN MESOPHILIC AND THERMOPHILIC TEMPERATURE RANGES, W70-02597	05D	02L SALT-WATER INTRUSION IN SOUTHEASTERN FLORIDA, W70-02486
THE PROTEOLYTIC BACTERIA PRESENT IN THE ANAEROBIC DIGESTION OF RAW SEWAGE SLUDGE, W70-02602	05D	PLANNING AND PROVIDING AN ADEQUATE SUPPLY OF WATER FOR ORANGE COUNTY, CALIFORNIA, W70-02487
ANAEROBIC FERMENTATION THE METHANE FERMENTATION BETWEEN MESOPHILIC AND THERMOPHILIC TEMPERATURE RANGES, W70-02597	05D	02L PROTECTING LONG ISLAND AQUIFERS AGAINST SALT-WATER INTRUSION, W70-02488
ANALOG COMPUTERS ANALOG SIMULATION OF ACTIVATED SLUDGE SYSTEMS, W70-02608	05D	02L THE CHALLENGE OF WATER MANAGEMENT ORANGE COUNTY WATER DISTRICT, CALIFORNIA, W70-02489
ANALYTICAL TECHNIQUES A FLUOROMETRIC METHOD FOR DETERMINING TRACE QUANTITIES OF FLUORIDE, W70-02726	07B	02L THE HYDROGEOLOGIC SETTING IN LOS ANGELES COUNTY, CALIFORNIA, W70-02490
A FLUOROMETRIC DETERMINATION OF IODIDE ION, W70-02727	07B	LEGAL AND ECONOMIC ASPECTS OF SALT-WATER ENCROACHMENT INTO COASTAL AQUIFERS, W70-02492
FLUOROMETRIC DETERMINATION OF OXALATE ION, W70-02728	07B	02L GEOCHEMISTRY AND ORIGIN OF FORMATION WATERS IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. STABLE ISOTOPES OF HYDROGEN AND OXYGEN, W70-02628
EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES, W70-02792	05C	02K ARCTIC DENSITY STRATIFIED LAKES IN NORTHERN ELLESMORE ISLAND, W70-02446
ANNUAL PLANTS PHYTOSOCIOLOGICAL VARIATIONS IN FLORISTIC COMPOSITION OF THE VEGETATION IN THE ARID ZONE I. MONSOONAL VEGETATION OF THE ALLUVIAL PLAINS, W70-02553	02I	02H RESULTS OF ATMOSPHERIC CIRCULATION STUDIES OVER EUROPE, ASIA, AND THE ARCTIC BY RADAR-METEOR TECHNIQUE (RUSSIAN), W70-02655
ANODIC POLARIZATION DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02693	08G	ARGON SOLUBILITIES OF NITROGEN, OXYGEN, AND ARGON IN DISTILLED WATER, W70-02701
W70-02742	08G	02K ARID LANDS FUTURE OF GROUND WATER IN AFRICAN SAHARA DESERT, W70-02452
APPROPRIATION THE LAW OF SURFACE WATER IN MISSOURI, W70-02579	04A	02F STUDIES IN THE TECHNIQUES OF FIELD TRIALS IN RANGE LANDS I. SIZE, SHAPE AND ARRANGEMENT OF PLOTS, W70-02551
W70-02581	04A	03F GERMINATION STUDIES OF PERENNIAL GRASS SEEDS, W70-02552
AQUATIC ALGAE PHYTOPLANKTON POPULATIONS IN RELATION TO TROPHIC LEVELS OF LAKES IN NEW HAMPSHIRE, U.S.A. W70-02772	05C	02I PHYTOSOCIOLOGICAL VARIATIONS IN FLORISTIC COMPOSITION OF THE VEGETATION IN THE ARID ZONE I. MONSOONAL VEGETATION OF THE ALLUVIAL PLAINS, W70-02553
EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES, W70-02792	05C	02F STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GROWTH AND FORAGE PRODUCTION OF DHARAM (CENCHRUS CILIARIS) AND SEWAN (LASIURUS SINDICUS) PASTURES IN THE ESTABLISHMENT YEAR, W70-02554
AQUATIC ANIMALS CLADOCERAN FAUNAS ASSOCIATED WITH AQUATIC MACROPHYTES IN SOME LAKES IN NORTHWESTERN MINNESOTA, W70-02789	02H	03F IRRIGATION IN ARID LANDS, W70-02559
MEASURING ORGANIC MATTER RETAINED BY AQUATIC INVERTEBRATES, W70-02790	05C	02A DESERTS THE PROBLEM OF WATER IN ARID LANDS, W70-02561
AQUATIC ENVIRONMENT INTERPRETATION OF RADIONUCLIDE UPTAKE FROM AQUATIC ENVIRONMENTS, W70-02786	05A	02D WATER REQUIREMENTS OF LAWNGRASS, W70-02562
AQUATIC HABITATS SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS, W70-02724	08C	02H MOUNTAIN AND DESERT LAKES IN SOUTHERN KAZAKHSTAN, THEIR RESOURCES AND METHODS OF ECONOMIC DEVELOPMENT, W70-02564
A PRELIMINARY ECOLOGICAL SURVEY OF THE WATER RESOURCES AND LAND USE PATTERNS OF THE DISMAL SWAMP AREA OF VIRGINIA, W70-02746	06G	02I EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS. VI. EFFECTS OF THE EXTERNAL OSMOTIC WATER POTENTIAL ON SOLUTE REQUIREMENT, SALT TRANSPORT KINETICS AND GROWTH RATES OF LEAVES, W70-02566
AQUATIC MICROBIOLOGY ECOLOGY OF SELECTED AQUATIC BACTERIA IN THE SNAKE RIVER, W70-02762	05C	02I ARTIFICIAL DESTRAFFICATION IMPOUNDMENT INFLUENCES ON WATER QUALITY, W70-02785
AQUATIC MICROFLORA AN INVESTIGATION OF THE STRUCTURAL CHEMISTRY OF YELLOW		05G ARTIFICIAL DRAINAGE DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE SIMULATION OF FLATLAND WATERSHED HYDRAULICS,

SUBJECT INDEX

ART-BLO

W70-02676	02G	BATCH ASSAYS BATCH ASSAYS FOR DETERMINATION OF ALgal GROWTH POTENTIAL, W70-02778	05A
ARTIFICIAL RECHARGE PLANNING AND PROVIDING AN ADEQUATE SUPPLY OF WATER FOR ORANGE COUNTY, CALIFORNIA, W70-02487	02L	BEACH EROSION MODELS COMPARISON OF WIND WAVE AND UNIFORM WAVE EFFECTS ON A BEACH, W70-02476	02L
PROTECTING LONG ISLAND AQUIFERS AGAINST SALT-WATER INTRUSION, W70-02488	02L	BEACHES COMPARISON OF WIND WAVE AND UNIFORM WAVE EFFECTS ON A BEACH, W70-02476	02L
THE HYDROGEOLOGIC SETTING IN LOS ANGELES COUNTY, CALIFORNIA, W70-02490	02L	BED LOAD BEDLOAD FORMULAS, W70-02671	02J
ATLANTIC SALMON INFLUENCE OF STARVATION ON SELECTED TEMPERATURE OF SOME SALMONIDS, W70-02706	05C	BED LOAD FORMULAS BEDLOAD FORMULAS, W70-02671	02J
ATMOSPHERE RESULTS OF ATMOSPHERIC CIRCULATION STUDIES OVER EUROPE, ASIA, AND THE ARCTIC BY RADAR-METEOR TECHNIQUE (RUSSIAN), W70-02655	02B	NEWS FISH AND GAME OYSTER GROUND LEASES. W70-02591	06E
SCATTERING AND ATTENUATION OF RADIATION BY WATER-FILMED HAIL (RUSSIAN), W70-02659	02C	LANDS MAY BE GRANTED OR EXCHANGED TO PROMOTE BOATING. W70-02682	06E
ATMOSPHERIC PRESSURE RESULTS OF ATMOSPHERIC CIRCULATION STUDIES OVER EUROPE, ASIA, AND THE ARCTIC BY RADAR-METEOR TECHNIQUE (RUSSIAN), W70-02655	02B	BENEFITS EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING, AND PREVENTING POLLUTION, B-166506, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION. W70-02743	05G
ATTACHED GROWTH EVALUATION OF FACTORS AFFECTING STREAM SELF-PURIFICATION, W70-02758	05G	BENTHIC FLORA STRUCTURAL CHARACTERISTICS OF BENTHIC ALgal COMMUNITIES IN LABORATORY STREAMS, W70-02780	05C
ATTENUATION SCATTERING AND ATTENUATION OF RADIATION BY WATER-FILMED HAIL (RUSSIAN), W70-02659	02C	BERLE SADDLES NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- II. NITRIFICATION IN TRICKLING FILTERS, W70-02604	05D
AUSTRALIA THE EFFECT OF GYPSUM ON THE WATER STORAGE IN A SANDY LOAM SOIL UNDER AN IRRIGATED PERENNIAL PASTURE, W70-02557	02G	BIBLIOGRAPHIES RIVER ICE JAMS - A LITERATURE REVIEW, W70-02494	02C
IRRIGATION IN ARID LANDS, W70-02559	03F	BIDS BIDS RECONSTRUCTION OF DESTROYED BRIDGES. W70-02824	04A
AUTOGENOUS COMBUSTION SLUDGE DISPOSAL EXPERIENCES AT NORTH LITTLE ROCK, ARKANSAS, W70-02616	05D	BIG BLACK RIVER(MISS) BIG BLACK RIVER, MISSISSIPPI COMPREHENSIVE BASIN STUDY - ANNEX F. GEOLOGY AND WATER RESOURCES, W70-02672	02E
AUTOTROPHIC MICROORGANISMS ENUMERATION OF AUTOTROPHIC AMMONIUM-OXIDIZING BACTERIA IN MARINE WATERS BY A DIRECT METHOD, W70-02507	07B	BIOASSAY BIOASSAY OF WATER POLLUTANTS WITH CULTURED MAMMALIAN CELLS, W70-02771	05A
BACTERIA ENUMERATION OF AUTOTROPHIC AMMONIUM-OXIDIZING BACTERIA IN MARINE WATERS BY A DIRECT METHOD, W70-02507	07B	BIOASSAYS NEED FOR ASSAYS, W70-02776	05A
BACTERIA RESPIRATION CORRECTIONS FOR BACTERIAL UPTAKE OF DISSOLVED ORGANIC COMPOUNDS IN NATURAL WATERS, W70-02641	05A	ALgal GROWTH ASSESSMENTS BY FLUORESCENCE TECHNIQUES, W70-02777	05A
AN INVESTIGATION OF THE STRUCTURAL CHEMISTRY OF YELLOW ORGANIC MATTER IN FRESH WATER, W70-02769	02K	CONTINUOUS-FLOW (CHEMOSTAT) ASSAYS, W70-02779	05A
MEMBRANE FILTER-FLUORESCENT-ANTIBODY METHOD FOR DETECTION AND ENUMERATION OF BACTERIA IN WATER, W70-02782	05A	BIOCHEMICAL OXYGEN DEMAND THE EFFECT OF ELEVATED TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE, W70-02710	05D
BACTERIA COUNTING ENUMERATION OF AUTOTROPHIC AMMONIUM-OXIDIZING BACTERIA IN MARINE WATERS BY A DIRECT METHOD, W70-02507	07B	BIOLOGICAL COMMUNITIES STRUCTURAL CHARACTERISTICS OF BENTHIC ALgal COMMUNITIES IN LABORATORY STREAMS, W70-02780	05C
BAIT DEALERS FISH AND GAME, W70-02815	06E	BIOLOGICAL MAGNIFICATION INTERACTION OF PESTICIDE POLLUTANTS AND AQUATIC FOOD-CHAIN ORGANISMS, W70-02677	05C
BAITS FISH AND GAME, W70-02815	06E	BIOLOGICAL TREATMENT COMPACT ACTIVATED-SLUDGE TREATMENT OF COMBINED PETROCHEMICAL MUNICIPAL WASTE, W70-02600	05D
BALTIC SEA TEMPERATURE FLUCTUATIONS SPECTRA IN THE SEA SURFACE LAYER (RUSSIAN), W70-02647	02L	THE EFFECT OF ELEVATED TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE, W70-02710	05D
BANK EROSION SHORE EROSION AND PROTECTION ST. LAWRENCE RIVER-CANADA, W70-02697	08A	EFFECT OF BORON ON BIOLOGICAL WASTE TREATMENT, W70-02734	05D
BANK STABILITY CONSTRUCTION OF THE KRASNAYARSK RESERVOIR AND ITS SHORE DEVELOPMENT (RUSSIAN), W70-02480	08A	BIOSTIMULATION PROCEEDINGS OF THE EUTROPHICATION-BIOSTIMULATION ASSESSMENT WORKSHOP, W70-02775	05A
BANK STABILIZATION LOCATION AND IMPROVEMENT OF RIVERS AND STREAMS, W70-02537	04A	BLOINDICATORS ECOLOGY OF SELECTED AQUATIC BACTERIA IN THE SNAKE RIVER, W70-02762	05C
BASE FLOW THEORETICAL BASEFLOW CURVES, W70-02460	02A	BLOOM SPECIES THE SUCCESSION OF 'BLOOM' SPECIES OF BLUE-GREEN ALGAE AND SOME CAUSAL FACTORS, W70-02684	02H

BLUF-GREEN ALGA		W70-02686	04A
BUOYANCY AND SINKING CHARACTERISTICS OF FRESHWATER PHYTOPLANKTON,	05G	B-NITROSTYRENE	
W70-02754		CORRELATION OF STRUCTURE VS ACTIVITY OF POLLUTANTS OF FRESH WATER,	
BOATING LANDS MAY BE GRANTED OR EXCHANGED TO PROMOTE BOATING.	06E	W70-02753	05C
W70-02682		CALCIUM SULFATE	
BOATS TAKING UP DRIPPING LUMBER.	06E	ULTRASONIC DETECTION OF CALCIUM SULFATE SCALE ON METAL SURFACES,	
W70-02806		W70-02690	08G
BODIES OF WATER POWERS, RIGHTS, AND PRIVILEGES OF RAILROAD CORPORATIONS TO CROSS WATERCOURSES.	04A	EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION,	
W70-02572		W70-02692	08G
BORON EFFECT OF BORON ON BIOLOGICAL WASTE TREATMENT,	05D	CALCUTTA(INDIA)	
W70-02734		FREQUENCY ANALYSIS OF RAINFALL INTENSITIES FOR CALCUTTA,	
BOUNDARIES(PROPERTY) STREAM BOUNDARIES.	06E	W70-02634	02B
W70-02523		CALIFORNIA	
JURISDICTION OF COUNTIES ON BOUNDARY WATERS.	06E	PLANNING AND PROVIDING AN ADEQUATE SUPPLY OF WATER FOR ORANGE COUNTY, CALIFORNIA,	
W70-02841		W70-02487	02L
BRIDGE CONSTRUCTION AUTHORITY TO ERECT BRIDGES.	06E	THE CHALLENGE OF WATER MANAGEMENT ORANGE COUNTY WATER DISTRICT, CALIFORNIA,	
W70-02812		W70-02489	02L
DELAWARE RIVER BRIDGE COMPACT.	06E	THE HYDROGEOLOGIC SETTING IN LOS ANGELES COUNTY, CALIFORNIA,	
W70-02813		W70-02490	02L
DELAWARE RIVER TUNNEL AND BRIDGE.	06E	THE AMELIORATION OR PREVENTION OF SALT-WATER INTRUSION IN AQUIFERS - EXPERIENCE IN LOS ANGELES COUNTY, CALIFORNIA,	
W70-02814		W70-02491	02L
BRIDGE FAILURE BIDS RECONSTRUCTION OF DESTROYED BRIDGES.	04A	LEGAL AND ECONOMIC ASPECTS OF SALT-WATER ENCROACHMENT INTO COASTAL AQUIFERS,	
W70-02824		W70-02492	02L
BRIDGES DELAWARE RIVER BRIDGES.	08A	REGRATION MEASUREMENTS IN AN ESTUARY,	
W70-02546		W70-02636	05G
DELAWARE RIVER JOINT TOLL BRIDGE COMMISSION.	04A	CANADA	
W70-02547		NUTRIENT-PHYTOPLANKTON RELATIONSHIPS IN EIGHT SOUTHERN ONTARIO LAKES,	
POWERS, RIGHTS, AND PRIVILEGES OF RAILROAD CORPORATIONS TO CROSS WATERCOURSES.	04A	W70-02795	05C
W70-02572		CARBONATE ROCKS	
CONSTRUCTING BRIDGES TO ELIMINATE GRADE CROSSINGS.	06E	GOLITIC ARAGONITE AND QUARTZ SAND LABORATORY COMPARISON UNDER WAVE ACTION,	
W70-02585		W70-02624	08E
LEASING OF TOLL BRIDGES.	06E	CASS COUNTY(N DAK)	
W70-02805		GEOLGY AND GROUNDWATER RESOURCES OF CASS COUNTY, NORTH DAKOTA PART 3,	
BRIDGES OVER NAVIGABLE WATERWAYS AND RAILROADS.	06E	W70-02675	02F
W70-02811		CELL YIELD	
AUTHORITY TO ERECT BRIDGES.	06E	ENERGY CONCEPTS OF AEROBIC MICROBIAL METABOLISM,	
W70-02812		W70-02613	05D
PIDS RECONSTRUCTION OF DESTROYED BRIDGES.	04A	CENTRIFUGATION	
W70-02824		SLUDGE DISPOSAL EXPERIENCES AT NORTH LITTLE ROCK, ARKANSAS,	
COUNTY'S RIGHT OF ENTRY FOR CONSTRUCTION.	06E	W70-02616	05D
W70-02825		CENTRIFUGE	
BRIDGES MADE SAFE.	06E	SLUDGE DISPOSAL EXPERIENCES AT NORTH LITTLE ROCK, ARKANSAS,	
W70-02839		W70-02616	05D
BRINES STALACTITE GROWTH BENEATH SEA ICE,	02C	CHANNEL IMPROVEMENTS	
W70-02620		STREAM CLEARANCE, RECTIFICATION AND IMPROVEMENT.	
BRINE SPRINGS IN THE ZWICKAU-OELSNITZ COAL AREA (GERMAN).	05B	W70-02827	08A
W70-02673		CHEMICAL ANALYSIS	
BROOK TROUT INFLUENCE OF STARVATION ON SELECTED TEMPERATURE OF SOME SALMONIDS,	05C	SEDIMENTARY PHOSPHORUS IN LAKE CORES--ANALYTICAL PROCEDURE,	
W70-02706		W70-02801	05A
EFFECTS OF SIMULTANEOUS VARIATION OF TEMPERATURE AND DISSOLVED OXYGEN ON THE RESISTANCE OF FISHES TO CONTROLLED POLLUTANTS,	05C	CHEMICAL DEGRADATION	
W70-02731		CHEMISTRY OF THE OXIDANT, FERRATE, ITS INTERACTION WITH SPECIFIC ORGANICS FOUND IN WASTE WATER,	
BULKHEAD LINE WHARVES, DOCKS, AND FERRIES.	04A	W70-02738	05G
W70-02822		CHEMICAL FACTORS	
WHARF LINES AT BRISTOL.	04A	SOME PHYSICAL AND CHEMICAL FACTORS IN THE METABOLISM OF LAKES,	
W70-02823		W70-02798	02B
BUOYANCY JETS WITH NEGATIVE BUOYANCY IN HOMOGENEOUS FLUID,	02E	CHEMICAL OXYGEN DEMAND	
W70-02715		THE EFFECT OF Elevated TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE,	
BURNED LIME HYDROBIOLOGICAL CONTROL OF THE TREATMENT OF WASTE WATERS IN ACCUMULATION PONDS (CZECH).	05B	W70-02710	05D
W70-02793		CHEMICAL PROPERTIES	
BURNING WATER REPELLENT SOILS A WORLDWIDE CONCERN IN MANAGEMENT OF SOIL AND VEGETATION,	05B	PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,	
		W70-02766	05C
		CHEROSTATS	
		CONTINUOUS-FLOW (CHEROSTAT) ASSAYS,	
		W70-02779	05A
		CHLORIDES	
		NEW MEASUREMENTS OF OXYGEN SOLUBILITY IN PURE AND NATURAL WATER,	
		W70-02712	02K
		CHLORINATED HYDROCARBON PESTICIDES	
		INFLUENCE OF pH ON THE ABSORPTION OF AROMATIC ACIDS ON ACTIVATED CARBON,	
		W70-02483	05G

EFFECTS OF CHLORINATED HYDROCARBON INSECTICIDES ON THE FRESHWATER SEED SHRIMP,		W70-02679	05C	W70-02660	07C
CHLORINITY				BURRICAINE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BAY ST. LOUIS QUADRANGLE, MISSISSIPPI,	
NEW TABLES FOR OXYGEN SATURATION OF SEAWATER,		W70-02704	01B	W70-02661	07C
NEW MEASUREMENTS OF OXYGEN SOLUBILITY IN PURE AND NATURAL WATER,		W70-02712	02K	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NW QUADRANGLE, MISSISSIPPI,	
CHLOROPHYTA				W70-02662	07C
THE IMPORTANCE OF PROTOZOA IN CONTROLLING THE ABUNDANCE OF PLANKTONIC ALGAE IN LAKES,		W70-02500	02H	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASS CHRISTIAN QUADRANGLE, MISSISSIPPI,	
CITIES				W70-02663	07C
STREAM BOUNDARIES.		W70-02523	06E	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NORTH-SOUTH QUADRANGLES, MISSISSIPPI,	
CITIES' POWER OVER WATERCOURSES.		W70-02524	04A	W70-02664	07C
CITIES OF THE SECOND CLASS POWERS RELATING TO LEVEES, FERRIES, WHARVES, CHANNELS, PIERS, AND INFLOW PIPES.		W70-02525	04A	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, VIDALIA QUADRANGLE, MISSISSIPPI,	
THE LAW OF SURFACE WATER IN MISSOURI,		W70-02562	04A	W70-02665	07C
PREVENTION OF FLOOD DAMAGE.		W70-02821	04A	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, WAVELAND-GRAND ISLAND PASS QUADRANGLES, MISSISSIPPI,	
SEWAGE POLLUTION.		W70-02833	05G	W70-02666	07C
CLADOCERAN				COLD REGIONS	
CLADOCERAN FAUNAS ASSOCIATED WITH AQUATIC MACROPHYTES IN SOME LAKES IN NORTHWESTERN MINNESOTA,		W70-02789	02H	DENSITY STRATIFIED LAKES IN NORTHERN ELLESmere ISLAND,	
CLADOPHORA				W70-02446	02H
CLADOPHORA GLOMERATA AND CONCOMITANT ALGAE IN THE RIVER SKAWA. DISTRIBUTION AND CONDITIONS OF APPEARANCE,		W70-02784	05C	COLIFORMS	
CLEARCUTTING				PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,	
SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS,		W70-02724	04C	W70-02766	05C
CLIMATOLOGY				MEMBRANE FILTER-FLUORESCENT-ANTIBODY METHOD FOR DETECTION AND ENUMERATION OF BACTERIA IN WATER,	
DESERTS THE PROBLEM OF WATER IN ARID LANDS,		W70-02561	02A	W70-02782	05A
CLOSED CONDUIT FLOW				COLORADO	
MOVEMENT OF SAND IN TUNNELS.		W70-02465	08B	LATEAL MIGRATIONS OF THE ARKANSAS RIVER DURING THE QUATERNARY-FOWLER, COLORADO, TO THE COLORADO-KANSAS STATE LINE,	
AIR ENTRAINMENT BY FLOWING WATER UNDER REDUCED ATMOSPHERIC PRESSURE,		W70-02474	02E	W70-02475	02J
CLOSED CONDUITS				COLORADO RIVER BASIN	
A STUDY OF FLOW CONDITIONS IN SHAFT SPILLWAYS,		W70-02774	08A	SUITABILITY OF THE UPPER COLORADO RIVER BASIN FOR PRECIPITATION MANAGEMENT,	
CLOUD SEEDING				W70-02622	03B
SUITABILITY OF THE UPPER COLORADO RIVER BASIN FOR PRECIPITATION MANAGEMENT.		W70-02622	03B	COLUMBIA RIVER	
COAGULATION				ALKALINITY BUDGET OF THE COLUMBIA RIVER,	
VIRUS REMOVAL BY CHEMICAL COAGULATION,		W70-02767	05F	W70-02642	02K
COAL MINES				COMBINED SEWERS	
BRINE SPRINGS IN THE ZWICKAU-OELSNITZ COAL AREA (GERMAN).		W70-02673	05B	DESIGN OF A COMBINED SEWER FLUIDIC REGULATOR, THE DEVELOPMENT OF BASIC CONFIGURATIONS AND DESIGN CRITERIA FOR APPLICATIONS OF FLUIDS IN SEWER REGULATORS.	
RIGHT TO RUN TUNNEL UNDER RIVER TO COAL MINE.		W70-02818	06E	W70-02773	04A
COASTAL STRUCTURES				COMBINATORIUM	
WHARVES, DOCKS, AND FERRIES.		W70-02822	04A	KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION,	
COASTS				W70-02611	05D
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, LOGTOWN QUADRANGLE, MISSISSIPPI,		W70-02497	02E	COMPACTED SOILS	
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, ENGLISH LOOKOUT QUADRANGLE, LOUISIANA-MISSISSIPPI,		W70-02498	02E	INVESTIGATION OF SOIL FREEZING,	
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KILN QUADRANGLE, MISSISSIPPI,		W70-02499	02E	W70-02750	08E
PARTICULATE ALUMINUM AND IRON IN SEA WATER OFF THE SOUTHEASTERN COAST OF THE UNITED STATES,		W70-02630	02K	COMPUTER PROGRAMS	
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUADRANGLES, MISSISSIPPI-ALABAMA,			FORTRAN-HYDRO,		
CONSULTANTS				W70-02453	07C
ENGINEERING ASPECTS OF WASTEWATER CONTRACTS,				CONDENSATION	
W70-02605				WHARVES, DOCKS, AND FERRIES.	
				W70-02822	04A
				STATE V ARCHER.	
				W70-02834	04D
				CONFERENCES	
				PROCEEDINGS OF THE EUTROPHICATION-BIOSTIMULATION ASSESSMENT WORKSHOP.	
				W70-02775	05A
				CONJUNCTIVE USE	
				A COMPREHENSIVE STUDY OF THE USE TAX AS A MEANS OF ALLOCATION OF WATER RESOURCES IN A CONJUNCTIVE USE SYSTEM,	
				W70-02757	06C
				CONNECTICUT	
				RELATION OF BEDROCK FRACTURE SYSTEMS TO UNDERGROUND WATER SUPPLIES IN THE STAFFORD SPRINGS, SOUTH CONVENTRY, SPRING HILL, AND WESTFORD QUADRANGLES,	
				W70-02756	02F
				CONSERVATION	
				CONSERVATION ACT.	
				W70-02816	03D
				CONSTRUCTION	
				REVETMENTS FOR BANK PROTECTION USING VERY ROUGH-SURFACED FERRO-CONCRETE ELEMENTS (FRENCH),	
				W70-02696	08A
				COUNTY'S RIGHT OF ENTRY FOR CONSTRUCTION.	
				W70-02825	06E
				CONSULTANTS	
				ENGINEERING ASPECTS OF WASTEWATER CONTRACTS,	
				W70-02605	05D

SUBJECT INDEX

CON-DEL

CONSUMPTIVE USE ALFALFA WATER TABLE INVESTIGATIONS, W70-02450	02I	CURRENT METERS A FALLING-PARTICLE CURRENT METER, W70-02670	07B
EXPRESSING IRRIGATION EFFICIENCY IN TERMS OF APPLICATION TIME, INTAKE AND WATER ADVANCE CONSTANTS, W70-02556	03F	CURRENTS CURRENT STUDY IN THE MEUSE RIVER AND ESTUARY OF NORTH CAROLINA, W70-02760	02L
CONTAINMENT EQUIPMENT COMBATING POLLUTION CREATED BY OIL SPILLS, VOLUME I METHODS, W70-02744	05G	CURRENTS(WATER) LINEAR EROSIONAL FURROWS IN SOUTHAMPTON WATER, W70-02445	02J
CONTINUOUS CULTURE CONTINUOUS-FLOW (CHEMOSTAT) ASSAYS, W70-02779	05A	SOME EFFECTS OF CURRENT VELOCITY ON PERiphyton COMMUNITIES IN LABORATORY STREAMS, W70-02794	05C
CONTRACTS ENGINEERING ASPECTS OF WASTEWATER CONTRACTS, W70-02605	05D	CYANIDES THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTES, W70-02614	05D
COOLING CONSIDERATIONS ON HYDRAULIC MODELS TO BE EMPLOYED TO STUDY RECIRCULATION INTAKE CONDITIONS OF COOLING WATER IN STEAM POWER STATIONS, W70-02707	05B	CYANOPHYTA PRESWATER PRIMARY PRODUCTION BY A BLUE-GREEN ALGA OF BACTERIAL SIZE, W70-02508	02H
USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES, W70-02709	05B	THE SUCCESSION OF 'BLOOM' SPECIES OF BLUE-GREEN ALGAE AND SOME CAUSAL FACTORS, W70-02684	02H
AN EVALUATION OF THE USE OF SELECTIVE DISCHARGES FROM LAKE ROOSEVELT TO COOL THE COLUMBIA RIVER, W70-02739	05B	CYSTEINE CORRELATION OF STRUCTURE VS ACTIVITY OF POLLUTANTS OF FRESH WATER, W70-02753	05C
COOLING WATER THERMAL DISCHARGES FROM LARGE NUCLEAR PLANT, W70-02635	05B	CYSTEINE-B-NITROSTYRENE INTERACTION CORRELATION OF STRUCTURE VS ACTIVITY OF POLLUTANTS OF FRESH WATER, W70-02753	05C
COORDINATION CONSERVATION OF NATURAL RESOURCES. W70-02587	03D	CYTOTOLOGICAL EFFECTS ALGAE IN RELATION TO MINE WATER, W70-02770	05C
COPPER WESTERN ELECTRIC BUILDS MODERN PLANT FOR TREATING METAL FINISHING WASTES, W70-02601	05D	DAM CONSTRUCTION REGULATION OF DAM AND MILLWAY CONSTRUCTION AND OPERATION. W70-02570	04A
COPPER ALLOYS SEA WATER CORROSION TEST PROGRAM, W70-02691	08G	DAM CONSTRUCTION REGULATION OF DAM AND MILLWAY CONSTRUCTION AND OPERATION. W70-02570	04A
CORES SEDIMENTARY PHOSPHORUS IN LAKE CORES--OBSERVATIONS ON DEPOSITIONAL PATTERN IN LAKE MENDOTA, W70-02800	02H	VIGILANCE OVER RESERVOIRS, W70-02639	06E
SEDIMENTARY PHOSPHORUS IN LAKE CORES--ANALYTICAL PROCEDURE, W70-02801	05A	DAMS UNLAWFUL ENTRY UPON RESERVOIRS, PONDS, AND DAMS. W70-02519	06E
CORROSION DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02693	08G	OBSTRUCTIONS NOT TO BE MADE OR ALTERED WITHOUT CONSENT. W70-02534	04A
CORROSION CONTROL SALT WATER CORROSION CONTROL BY ENVIRONMENT MODIFICATION, W70-02689	08G	REGULATION OF DAM AND MILLWAY CONSTRUCTION AND OPERATION. W70-02570	04A
DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02742	08G	MILL DAMS. W70-02586	06E
COST ALLOCATION CLAIMS AGAINST AND CONTRACTS WITH OTHER DISTRICTS AND MUNICIPAL CORPORATIONS EXERCISING DRAINAGE POWERS. W70-02516	04A	HYDROGRAPHIC AND SEDIMENTATION SURVEY OF KAJAKAI RESERVOIR, AFGHANISTAN, W70-02669	02J
A COMPREHENSIVE STUDY OF THE USE TAX AS A MEANS OF ALLOCATION OF WATER RESOURCES IN A CONJUNCTIVE USE SYSTEM, W70-02757	06C	DAMS AND STORAGE RESERVOIR. W70-02829	04A
COST ANALYSIS COMBATING POLLUTION CREATED BY OIL SPILLS, VOLUME I METHODS, W70-02744	05G	POWERS OF THE DEPARTMENT OF RESOURCE DEVELOPMENT. W70-02842	04A
COST COMPARISONS A COMPREHENSIVE STUDY OF THE USE TAX AS A MEANS OF ALLOCATION OF WATER RESOURCES IN A CONJUNCTIVE USE SYSTEM, W70-02757	06C	DARCY'S LAW AN INVESTIGATION OF THE FLOW REGIME FOR HELE-SHAW FLOW, W70-02470	08B
COSTS HISTORICAL, FIELD AND EXPERIMENTAL STUDIES OF THE SUEZ CANAL BANK PROTECTION, W70-02698	08A	DATA COLLECTIONS AN INVESTIGATION OF FLOODS IN HAWAII THROUGH SEPTEMBER 30, 1968, W70-02471	07C
COVES FREE AND COMMON SHELLFISHERIES. W70-02590	06E	FLOODS IN TRIPLETT CREEK IN VICINITY OF MOREHEAD, KENTUCKY, W70-02896	02E
CRABS FREE AND COMMON SHELLFISHERIES. W70-02590	06E	DATA PROCESSING FORTRAN-HYDRO, W70-02453	07C
CRYSTAL GROWTH EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION, W70-02692	08G	DEAERATION SALT WATER CORROSION CONTROL BY ENVIRONMENT MODIFICATION, W70-02689	08G
CULTURES BATCH ASSAYS FOR DETERMINATION OF ALGAL GROWTH POTENTIAL, W70-02778	05A	SEA WATER CORROSION TEST PROGRAM, W70-02691	08G
		DECISION MAKING MULTIPLE USE OF MEDITERRANEAN RANGE LANDS NEW APPROACHES TO OLD PROBLEMS, W70-02567	03P
		DEEP WELLS DEEP WELL DISPOSAL OF WASTEWATERS IN SALINE AQUIFERS OF SOUTH FLORIDA, W70-02468	05E
		DELAWARE EFFECT OF BORON ON BIOLOGICAL WASTE TREATMENT,	

SUBJECT INDEX

DEL-DRA

W70-02734	05D	W70-02747	05C
DELAWARE RIVER FISHING REGULATIONS APPLYING TO BOUNDARY RIVERS. W70-02809	06E	DIATOMS BUOYANCY AND SINKING CHARACTERISTICS OF FRESHWATER PHYTOPLANKTON, W70-02754	05G
DELAWARE RIVER BRIDGE COMPACT. W70-02813	06E	DIFFUSION(SELF) INTERACTION OF INORGANIC AND ORGANIC FERTILIZER MATERIALS WITH PESTICIDES AS RELATED TO WATER QUALITY IN SOILS, W70-02761	05B
DELAWARE RIVER TUNNEL AND BRIDGE. W70-02814	06E	DIGESTION THE METHANE FERMENTATION BETWEEN MESOPHILIC AND THERMOPHILIC TEMPERATURE RANGES, W70-02597	05D
WHARF LINES AT BRISTOL. W70-02823	04A	ANAEROBIC DIGESTION I. THE MICROBIOLOGY OF ANAEROBIC DIGESTION (REVIEW PAPER), W70-02603	05D
FLOATING LUMBER ON THE DELAWARE RIVER. W70-02826	06E	DIMENSIONAL ANALYSIS NONLINEAR FLOW IN POROUS MEDIA, W70-02464	02F
DAMS AND STORAGE RESERVOIR. W70-02829	04A	DISMAL SWAMP A PRELIMINARY ECOLOGICAL SURVEY OF THE WATER RESOURCES AND LAND USE PATTERNS OF THE DISMAL SWAMP AREA OF VIRGINIA, W70-02746	06G
DELAWARE RIVER BASIN COMMISSION POLLUTION OF WATERS. W70-02538	05G	DISPERSIONS DESIGN PRINCIPLES OF WASTE STABILIZATION PONDS, W70-02609	05D
TRANSFER OF POWERS. W70-02830	06E	DISPUTES ENGINEERING ASPECTS OF WASTEWATER CONTRACTS, W70-02605	05D
DENITRIFICATION NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- III. DENITRIFICATION IN THE MODIFIED ACTIVATED SLUDGE PROCESS, W70-02607	05D	DISSOLVED ORGANIC MATTER INTERRELATIONS OF DISSOLVED ORGANIC MATTER AND PHYTOPLANKTON, W70-02510	05C
KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION, W70-02611	05D	DISSOLVED OXYGEN SEA WATER CORROSION TEST PROGRAM, W70-02691	08G
DENSITY POLYWATER PROTON NUCLEAR MAGNETIC RESONANCE SPECTRUM, W70-02618	01A	SOLUBILITY OF ATMOSPHERIC OXYGEN IN WATER, W70-02702	02K
DENSITY CURRENTS DENSITY FLOW REGIME OF ROOSEVELT LAKE, W70-02716	02H	NEW TABLES FOR OXYGEN SATURATION OF SEAWATER, W70-02704	01B
A HYDRAULIC MODEL STUDY OF HEAT DISSIPATION AT KINCARDINE POWER STATION, W70-02717	05B	DETERMINATION OF DISSOLVED OXYGEN BY THE WINKLER METHOD AND THE SOLUBILITY OF OXYGEN IN PURE WATER AND SEA WATER, W70-02705	02K
DENSITY STRATIFICATION LINEAR EROSIONAL FURROWS IN SOUTHAMPTON WATER, W70-02445	02J	NEW MEASUREMENTS OF OXYGEN SOLUBILITY IN PURE AND NATURAL WATER, W70-02712	02K
DENSITY STRATIFIED LAKES IN NORTHERN ELLESMORE ISLAND, W70-02446	02H	DISSOLVED-OXYGEN SALT WATER CORROSION CONTROL BY ENVIRONMENT MODIFICATION, W70-02689	08G
DISCHARGE OF SEWAGE EFFLUENT FROM A LINE SOURCE INTO A STRATIFIED OCEAN, W70-02714	05D	DISTILLATION DESALINATION EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION, W70-02692	08G
DEPTH-ARPA-DURATION ANALYSIS FREQUENCY ANALYSIS OF RAINFALL INTENSITIES FOR CALCUTTA, W70-02634	02B	DITCHES DRAINAGE RIGHTS, W70-02515	04A
DESALINATION SALT WATER CORROSION CONTROL BY ENVIRONMENT MODIFICATION, W70-02689	08G	DOCKS WHARVES, DOCKS, HARBORS, W70-02569	06E
DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02693	08G	WHARF LINES AT BRISTOL. W70-02823	04A
EVALUATION OF TITANIUM-PLATED STEEL IN A CHLORIDE ENVIRONMENT, W70-02741	08G	DOMESTIC WASTES THE EFFECT OF ELEVATED TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE, W70-02710	05D
DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02742	08G	DRAIN CONSTRUCTION PETITION TO COURT FOR DRAINAGE AND APPOINTMENT OF COMMISSIONERS, W70-02520	04A
DESALINATION PROCESS STUDY OF A DESIGN-OPTIMIZATION PROCEDURE FOR ION-EXCHANGE AND ADSORPTION COLUMNS, W70-02687	03A	DRAINAGE ANALYSIS OF INFILTRATION INTO DRAINING POROUS MEDIA, W70-02448	02G
AXIAL-DISPERSION CONSTANT-PATTERN KINETICS OF ION-EXCHANGE AND ADSORPTION COLUMNS, W70-02688	03A	A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967, W70-02495	06B
DESALINATION PROCESSES VALUE OF DESALTED WATER FOR IRRIGATION, W70-02632	03C	DRAINAGE RIGHTS. W70-02515	04A
DESERTS SOIL FORMATION AND SALT MIGRATION IN THE MURGAB RIVER DELTA, W70-02565	02G	PETITION TO COURT FOR DRAINAGE AND APPOINTMENT OF COMMISSIONERS, W70-02520	04A
SOME EXPERIENCE IN THE DEVELOPMENT OF LAND IN THE NEW IRRIGATION ZONE IN THE GOLODMAYA STEPPE (RUSSIAN). W70-02648	03F	DISCHARGE OF SEWAGE ON OR WITHIN LIMITS OF HIGHWAY. W70-02545	04E
DESIGN DATA STABILIZATION OF AN ACTIVATED SLUDGE PLANT, W70-02593	05D	DRAINAGE DENSITY DETERMINATION OF SPACINGS OF PARALLEL DRAINAGE SECTIONS AND FILTER-WELL SERIES IN OPENCAST MINE DRAINAGES (GERMAN), W70-02674	05G
DESILTING SCHUYLKILL RIVER POLLUTION. W70-02828	05G		
DETERGENT STUDIES ON PHOSPHOROUS TRANSFORMATIONS IN EUTROPHIC LAKES.			

SUBJECT INDEX

DRA-FST

DRAINAGE DISTRICTS CLAIMS AGAINST AND CONTRACTS WITH OTHER DISTRICTS AND MUNICIPAL CORPORATIONS EXERCISING DRAINAGE POWERS. W70-02516	04A	EFFLUENT STREAMS THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTES, W70-02614	05D
THE LAW OF SURFACE WATER IN MISSOURI. W70-02582	04A	ELASTIC WAVE PROPAGATION DYNAMIC BEHAVIOR OF SOIL, W70-02751	08E
DRAINAGE EFFECTS DETERMINATION OF SPACINGS OF PARALLEL DRAINAGE SECTIONS AND FILTER-WELL SERIES IN OPENCAST MINE DRAINAGES (GERMAN). W70-02674	05G	ELECTRICAL SYSTEM DESIGN PLANNING FOR POWER - A LOOK AT TOMORROWS STATION SIZES, W70-02740	08C
DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE SIMULATION OF FLATLAND WATERSHED HYDRAULICS. W70-02676	02G	ELECTROCHEMISTRY DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02742	08G
DRAINAGE ENGINEERING DETERMINATION OF SPACINGS OF PARALLEL DRAINAGE SECTIONS AND FILTER-WELL SERIES IN OPENCAST MINE DRAINAGES (GERMAN). W70-02674	05G	ELLESmere ISLAND DENSITY STRATIFIED LAKES IN NORTHERN ELLESmere ISLAND, W70-02446	02H
DRAINAGE PROGRAMS POWERS OF THE DEPARTMENT OF RESOURCE DEVELOPMENT. W70-02842	04A	EMINENT DOMAIN WHARVES, DOCKS, HARBORS. W70-02569	06E
DRAINAGE RIGHTS DRAINAGE RIGHTS. W70-02515	04A	STATE V ARCHER. W70-02834	04D
DRAINAGE SYSTEMS CLAIMS AGAINST AND CONTRACTS WITH OTHER DISTRICTS AND MUNICIPAL CORPORATIONS EXERCISING DRAINAGE POWERS. W70-02516.	04A	ENERGY ENERGY CONCEPTS OF AEROBIC MICROBIAL METABOLISM. W70-02613	05D
INTERFERENCE WITH DRAINAGE FACILITIES. W70-02526	04A	ENGLAND LINEAR EROSIONAL FURROWS IN SOUTHAMPTON WATER, W70-02445	02J
DRAINS DRAINAGE RIGHTS. W70-02515	04A	ENTHALPY THE DETERMINATION OF THE ENGINEERING THERMO-PHYSICAL PROPERTIES OF SOLUTIONS CONTAINING DISSOLVED SOLIDS, W70-02749	02K
DRAWDOWN THE INTERPRETATION OF INTERFERENCE TESTS IN NATURALLY FRACTURED RESERVOIRS WITH UNIFORM FRACTURE DISTRIBUTION, W70-02469	08B	ENTRAINMENT JETS WITH NEGATIVE BUOYANCY IN HOMOGENEOUS FLUID, W70-02715	02E
DUPUIT-FOCHHEIMER THEORY GROUND WATER SEEPAGE PATTERNS TO WELLS FOR UNCONFINED FLOW, W70-02759	02G	ENTROPY THE DETERMINATION OF THE ENGINEERING THERMO-PHYSICAL PROPERTIES OF SOLUTIONS CONTAINING DISSOLVED SOLIDS, W70-02749	02K
DURATION CURVES FREQUENCY ANALYSIS OF RAINFALL INTENSITIES FOR CALCUTTA, W70-02634	02B	ENVIRONMENTAL EFFECTS IRRIGATION IN ARID LANDS, W70-02559	03F
DYKES POWERS OF THE DEPARTMENT OF RESOURCE DEVELOPMENT. W70-02842	04A	CLEANING OUR ENVIRONMENT - THE CHEMICAL BASIS FOR ACTION, W70-02640	05G
ECOLOGICAL STUDY FACTOR ANALYSIS AS AN AID IN AN ECOLOGICAL STUDY OF ANAEROBIC DIGESTION, W70-02594	05D	THE SUCCESSION OF 'BLOOM' SPECIES OF BLUE-GREEN ALGAE AND SOME CAUSAL FACTORS, W70-02684	02H
ECOLOGY PHOTOSOCIOLOGICAL VARIATIONS IN FLORISTIC COMPOSITION OF THE VEGETATION IN THE ARID ZONE I. MONSOONAL VEGETATION OF THE ALLUVIAL PLAINS, W70-02553	02I	ALGAE IN RELATION TO MINE WATER, W70-02770	05C
A PRELIMINARY ECOLOGICAL SURVEY OF THE WATER RESOURCES AND LAND USE PATTERNS OF THE DISMAL SWAMP AREA OF VIRGINIA, W70-02746	06G	ENVIRONMENTAL ENGINEERING DESIGN PRINCIPLES OF WASTE STABILIZATION PONDS, W70-02609	05D
ECONOMETRIC MODELS OPERATIONS RESEARCH STUDY OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT OF THE TUCSON BASIN, W70-02680	06A	CLEANING OUR ENVIRONMENT - THE CHEMICAL BASIS FOR ACTION, W70-02640	05G
ECONOMIC EFFICIENCY GERMINATION STUDIES OF PERENNIAL GRASS SEEDS, W70-02552	02I	ENVIRONMENTAL MANAGEMENT CLEANING OUR ENVIRONMENT - THE CHEMICAL BASIS FOR ACTION, W70-02640	05G
INLAND WATERWAY TRANSPORTATION, STUDIES IN PUBLIC AND PRIVATE MANAGEMENT AND INVESTMENT DECISIONS, W70-02700	06B	ENVIRONMENTAL SANITATION CLEANING OUR ENVIRONMENT - THE CHEMICAL BASIS FOR ACTION, W70-02640	05G
ECONOMIC IMPACT THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA, W70-02479	03F	EQUATIONS BEDLOAD FORMULAS, W70-02671	02J
ECONOMICS THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA, W70-02479	03F	EROSION LINEAR EROSIONAL FURROWS IN SOUTHAMPTON WATER, W70-02445	02J
ECOSYSTEMS SOME FACTORS AFFECTING RESPIRATION OF PERiphyton COMMUNITIES IN LOTIC ENVIRONMENTS, W70-02781	05C	EFFECTS OF UNIT WEIGHT AND SLOPE ON EROSION, W70-02451	02J
SOME EFFECTS OF CURRENT VELOCITY ON PERiphyton COMMUNITIES IN LABORATORY STREAMS, W70-02794	05C	OOLITIC ARAGONITE AND QUARTZ SAND UNDER WAVE ACTION, W70-02624	LABORATORY COMPARISON 08E
EFFLUENT STANDARDS DELAWARE RIVER BASIN COMMISSION ANNUAL REPORT 1969. W70-02694	05G	EROSION CONTROL SOIL CONSERVATION POLICY. W70-02521	04D
ESTUARIES WATER QUALITY IN INDUSTRIAL AREAS PROFILE OF A RIVER, W70-02493	05C	EROSION PREVENTION EXPERIMENTS, W70-02730	04D
EROSION STATE V ARCHER. W70-02834	04D	STATE V ARCHER. W70-02834	04D
ESTUARIES WATER QUALITY IN INDUSTRIAL AREAS PROFILE OF A RIVER, W70-02493	05C	EROSION MEASUREMENTS IN AN ESTUARY, W70-02636	05G

TEMPERATURE FLUCTUATIONS SPECTRA IN THE SEA SURFACE LAYER (RUSSIAN), W70-02647	02L	W70-02504	05B
CURRENT STUDY IN THE NEUSE RIVER AND ESTUARY OF NORTH CAROLINA, W70-02760	02L	FACTOR ANALYSIS FACTOR ANALYSIS AS AN AID IN AN ECOLOGICAL STUDY OF ANAEROBIC DIGESTION, W70-02594	05D
ESTUARINE FISHERIES THE ECOLOGY OF THE YOUNG FISHES OF THE NEWENANTIC RIVER ESTUARY, W70-02678	05C	FEDERAL BUDGETS REMARKS BY CONGRESSMAN WILLIAM C. CRAMER BEFORE THE 56TH ANNUAL CONVENTION, NATIONAL RIVERS AND HARBORS CONGRESS, W70-02513	05G
ESTUARIES LINEAR EROSIONAL FURROWS IN SOUTHAMPTON WATER, W70-02445	02J	FEDERAL JURISDICTION INTERSTATE COMMERCE - NAVIGABLE RIVERS - INDUSTRIAL WASTE CLOGGING CHANNEL HELD NOT UNLAWFUL OBSTRUCTION - UNITED STATES V REPUBLIC STEEL CORP (7TH CIR 1959). W70-02512	05G
EUTROPHICATION REPORT ON THE NUTRIENT SOURCES OF LAKE MENDOTA. W70-02506	05B	FEDERAL PROJECT POLICY REMARKS BY CONGRESSMAN WILLIAM C. CRAMER BEFORE THE 56TH ANNUAL CONVENTION, NATIONAL RIVERS AND HARBORS CONGRESS. W70-02513	05G
NUTRIENT LIMITATION OF SUMMER PHYTOPLANKTON GROWTH IN CAYUGA LAKE, W70-02643	05C	FEDERAL RECLAMATION LAW PUBLIC LANDS AND SWAMPS - SALES - PUBLIC USE. W70-02588	04A
LIMITATION OF ALgal GROWTH IN SOME CENTRAL AFRICAN WATERS, W70-02646	05C	FERRATE CHEMISTRY OF THE OXIDANT, FERRATE, ITS INTERACTION WITH SPECIFIC ORGANICS FOUND IN WASTE WATER, W70-02738	05G
STUDIES ON PHOSPHOROUS TRANSFORMATIONS IN EUTROPHIC LAKES, W70-02747	05C	FERRIES CITIES OF THE SECOND CLASS POWERS RELATING TO LEVEES, FERRIES, WHARVES, CHANNELS, PIERS, AND INFLOW PIPES. W70-02525	04A
NEED FOR ASSAYS, W70-02776	05A	FERTILIZATION REPORT ON THE NUTRIENT SOURCES OF LAKE MENDOTA. W70-02506	05B
CONTRIBUTIONS TO THE KNOWLEDGE OF NITROGENOUS COMPOUNDS AND PHOSPHATE IN THE LAKE WATERS OF JAPAN, W70-02788	05C	FERTILIZATION OF LAKES BY AGRICULTURAL AND URBAN DRAINAGE, W70-02787	05B
THE OBLITERATION OF THE HYPOLIMNION, W70-02797	05C	FILTER WELLS DETERMINATION OF SPACINGS OF PARALLEL DRAINAGE SECTIONS AND FILTER-WELL SERIES IN OPENCAST MINE DRAINAGES (GERMAN), W70-02674	05G
EUTROPHICATION AND SENESCENCE IN A GROUP OF PRAIRIE-PARKLAND LAKES IN ALBERTA, CANADA, W70-02802	05C	FILTRATION NONLINEAR FLOW IN POROUS MEDIA, W70-02464	02F
OBJECTIONABLE ALGAE WITH REFERENCE TO THE KILLING OF FISH AND OTHER ANIMALS, W70-02803	05C	FILTRATION PROPERTIES OF THE SOIL OF THE MOUNTAINS ON THE NORTHERN SLOPE OF TRANSILIAN ALA TAU (RUSSIAN), W70-02652	02G
EVALUATION INLAND WATERWAY TRANSPORTATION, STUDIES IN PUBLIC AND PRIVATE MANAGEMENT AND INVESTMENT DECISIONS, W70-02700	06B	IRON AND MANGANESE REMOVAL FROM SMALL GROUNDWATER SUPPLIES, W70-02755	05F
STUDY OF EQUIPMENT AND METHODS FOR REMOVING OIL FROM HARBOR WATERS, W70-02725	05G	FINANCING FLOOD CONTROL. W70-02576	04A
EVAPORATION IRRIGATION IN ARID LANDS, W70-02559	03F	ENGINEERING ASPECTS OF WASTEWATER CONTRACTS, W70-02605	05D
TOTAL SUMMER EVAPORATION IN THE CENTRAL MOUNTAIN BELT OF TRANSILIAN ALATAU AND THE EFFECT OF SLOPE EXPOSURE ON EVAPORATION (RUSSIAN), W70-02651	02D	MUNICIPAL ASSISTANCE. W70-02808	06E
THE EFFECT OF THE ADDITION OF HEAT FROM A POWERPLANT ON THE THERMAL STRUCTURE AND EVAPORATION OF LAKE COLORADO CITY, TEXAS, W70-02703	02D	FISH FISH AND GAME. W70-02815	06E
EVAPOTRANSPIRATION ALFALFA WATER TABLE INVESTIGATIONS, W70-02450	02I	FISH BARRIERS DAMS, FISCHWAYS, BAR-RACKS, OBSTRUCTIONS. W70-02810	06E
WATER REQUIREMENTS OF LAWNGRASS, W70-02562	02D	FISH CONSERVATION POLLUTION TRESPASS ON STATE HATCHERIES. W70-02543	05G
MEASUREMENT OF EVAPOTRANSPIRATION IN LOWLAND VEGETATION, W70-02733	02D	FISH CONSERVATION. W70-02836	05G
EVERGLADES SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK, W70-02631	04C	FISH AND GAME. W70-02837	06E
EXCRETION PHOSPHORUS EXCRETION AND BODY SIZE IN MARINE ANIMALS MICROZOOPLANKTON AND NUTRIENT REGENERATION, W70-02791	05C	FISH CONTROL AGENTS CONSERVATION AND CONTROL OF AQUATIC PLANTS AND FISH. W70-02838	04A
EXPENSES ENGINEERING ASPECTS OF WASTEWATER CONTRACTS, W70-02605	05D	FISH DEALERS FISH AND GAME. W70-02815	06E
PRELIMINARY DESIGN OF WASTEWATER TREATMENT SYSTEMS, W70-02610	05D	FISH FARMING HYDROBIOLOGICAL CONTROL OF THE TREATMENT OF WASTE WATERS IN ACCUMULATION PONDS (CZECH). W70-02793	05B
EXPERIMENTAL DESIGNS STUDIES IN THE TECHNIQUES OF FIELD TRIALS IN RANGE LANDS I. SIZE, SHAPE AND ARRANGEMENT OF PLOTS, W70-02551	03F	FISH HATCHERIES POLLUTION TRESPASS ON STATE HATCHERIES. W70-02543	05G
EXTENDED AERATION KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION, W70-02611	05D	CULTIVATION OF FISH. W70-02718	06E
EXTRACELLULAR PRODUCTS EXTRACELLULAR PRODUCTS OF PHYTOPLANKTON PHOTOSYNTHESIS,		ARTIFICIAL PROPAGATION LICENSES AND SPINE LICENSES. W70-02831	06E

FISH MANAGEMENT PENNSYLVANIA FISHING REGULATIONS APPLYING TO INLAND WATERS AND BOUNDARY LAKES. W70-02542	06E	W70-02533 06E
FREE AND COMMON SHELLFISHERIES. W70-02590	06E	FLOOD CONTROL. W70-02573 04A
FISHING LICENSES. W70-02598	06E	W70-02574 04A
CULTIVATION OF FISH. W70-02599	06E	PREVENTION OF FLOOD DAMAGE. W70-02821 04A
W70-02718	06E	STREAM CLEARANCE, RECTIFICATION AND IMPROVEMENT. W70-02827 04A
PROTECTION OF FISHING GROUNDS. W70-02737	06E	FLOOD CONTROL DISTRICTS FLOOD CONTROL. W70-02573 04A
CONSERVATION ACT. W70-02816	03D	W70-02574 04A
FISH MIGRATION DAMS, FISHWAYS, BAR-RACKS, OBSTRUCTIONS. W70-02810	06E	FLOOD DAMAGE HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, LOGTOWN QUADRANGLE, MISSISSIPPI, W70-02497 02E
FISH PASSAGES DAMS, FISHWAYS, BAR-RACKS, OBSTRUCTIONS. W70-02810	06E	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, ENGLISH LOOKOUT QUADRANGLE, LOUISIANA-MISSISSIPPI, W70-02498 02E
FISH POPULATIONS THE ECOLOGY OF THE YOUNG FISHES OF THE NEWBERRY RIVER ESTUARY. W70-02678	05C	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KILM QUADRANGLE, MISSISSIPPI, W70-02499 02E
A PRELIMINARY ECOLOGICAL SURVEY OF THE WATER RESOURCES AND LAND USE PATTERNS OF THE DISHAW SWAMP AREA OF VIRGINIA. W70-02746	06G	FLOOD PLAIN INFORMATION OF SCAUAQUADA CREEK, IN THE TOWNS OF CHEKTOWAGA AND LANCASTER, ERIE COUNTY, NEW YORK. W70-02629 04A
FISH REPRODUCTION CULTIVATION OF FISH. W70-02599	06E	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUADRANGLES, MISSISSIPPI-ALABAMA, W70-02660 07C
FISHERIES TOWN CONTROL OF FISHERIES. W70-02592	06E	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BAY ST. LOUIS QUADRANGLE, MISSISSIPPI, W70-02661 07C
CULTIVATION OF FISH. W70-02599	06E	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NW QUADRANGLE, MISSISSIPPI, W70-02662 07C
W70-02718	06E	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASS CHRISTIAN QUADRANGLE, MISSISSIPPI, W70-02663 07C
FISHING REGULATION OF HUNTING AND FISHING IN INTERSTATE WATERS. W70-02502	06E	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NORTH-SOUTH QUADRANGLES, MISSISSIPPI, W70-02664 07C
PENNSYLVANIA FISHING REGULATIONS APPLYING TO INLAND WATERS AND BOUNDARY LAKES. W70-02542	06E	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, VIDALIA QUADRANGLE, MISSISSIPPI, W70-02665 07C
FISHING LICENSES. W70-02598	06E	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, WAVELAND-GRAND ISLAND PASS QUADRANGLES, MISSISSIPPI, W70-02666 07C
FISHING BY NON-RESIDENTS. W70-02732	06E	FLOOD PLAIN INFORMATION OF CANANDAIGUA OUTLET IN THE COUNTIES OF ONTARIO AND WAYNE, NEW YORK. W70-02667 04A
PROTECTION OF FISHING GROUNDS. W70-02737	06E	FLOOD FORECASTING DATA ERROR EFFECTS IN UNIT HYDROGRAPH DERIVATION. W70-02454 07A
FISHING REGULATIONS APPLYING TO BOUNDARY RIVERS. W70-02809	06E	FLOOD PROTECTION FLOOD CONTROL. W70-02531 04A
FISHING GEAR PENNSYLVANIA FISHING REGULATIONS APPLYING TO INLAND WATERS AND BOUNDARY LAKES. W70-02542	06E	UNITED STATES PROJECTS. W70-02533 06E
FISHING REGULATIONS APPLYING TO BOUNDARY RIVERS. W70-02809	06E	OBSTRUCTIONS NOT TO BE MADE OR ALTERED WITHOUT CONSENT. W70-02534 04A
FISH KILL FISH CONSERVATION. W70-02836	05G	PREVENTION OF FLOOD DAMAGE. W70-02821 04A
FIXED-BED STUDY OF A DESIGN-OPTIMIZATION PROCEDURE FOR ION-EXCHANGE AND ADSORPTION COLUMNS. W70-02687	03A	FLOOD RECORDS(HAWAII) AN INVESTIGATION OF FLOODS IN HAWAII THROUGH SEPTEMBER 30, 1968. W70-02471 07C
FIXED-BED SEPARATION AXIAL-DISPERSION CONSTANT-PATTERN KINETICS OF ION-EXCHANGE AND ADSORPTION COLUMNS. W70-02688	03A	FLOOD ROUTING FLOOD CONTROL. W70-02575 04A
FLXIBLE MATTRESS METHODS OF BANK PROTECTION FOR PORT, INLAND WATER-WAY AND RIVER. W70-02699	08A	FLOODING UNITED STATES PROJECTS. W70-02533 06E
FLOCULATION VIRUS REMOVAL BY CHEMICAL COAGULATION. W70-02767	05F	FLOODPROOFING FLOOD CONTROL. W70-02531 04A
FLOOD CONTROL FLOOD CONTROL. W70-02531	04A	FLOODS AN INVESTIGATION OF FLOODS IN HAWAII THROUGH SEPTEMBER 30, 1968. W70-02471 07C
FORESTATION SURVEY. W70-02532	04D	FLOODS OF JUNE 1, 1967 IN SOUTHWESTERN JACKSON, MISSISSIPPI. W70-02477 02E
UNITED STATES PROJECTS.		FLOODS IN TRIPPLETT CREEK IN VICINITY OF MOREHEAD, KENTUCKY,

SUBJECT INDEX

FLO-GER

W70-02496	02E	FRICITION FACTORS FOR FLOW IN SAND-BED CHANNELS, W70-02461	02J
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, LOGTOWN QUADRANGLE, MISSISSIPPI, W70-02497	02E	FLUIDIC	
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, ENGLISH LOOKOUT QUADRANGLE, LOUISIANA-MISSISSIPPI, W70-02498	02E	DESIGN OF A COMBINED SEWER FLUIDIC REGULATOR, THE DEVELOPMENT OF BASIC CONFIGURATIONS AND DESIGN CRITERIA FOR APPLICATIONS OF FLUIDS IN SEWER REGULATORS. W70-02773	04A
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KILN QUADRANGLE, MISSISSIPPI, W70-02499	02E	FLUORESCENCE	
FLOODS IN MISSISSIPPI-SEPTEMBER 1965 THROUGH SEPTEMBER 1967, W70-02621	02E	A FLUOROMETRIC METHOD FOR DETERMINING TRACE QUANTITIES OF FLUORIDE, W70-02726	07B
FLOOD PLAIN INFORMATION OF SCAUAQUADA CREEK, IN THE TOWNS OF CREEKTONAWA AND LANCASTER, ERIE COUNTY, NEW YORK. W70-02629	04A	A FLUOROMETRIC DETERMINATION OF IODIDE ION, W70-02727	07B
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUADRANGLES, MISSISSIPPI-ALABAMA, W70-02660	07C	FLUOROMETRIC DETERMINATION OF OXALATE ION, W70-02728	07B
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BAY ST. LOUIS QUADRANGLE, MISSISSIPPI, W70-02661	07C	MEMBRANE FILTER-FLUORESCENT-ANTIBODY METHOD FOR DETECTION AND ENUMERATION OF BACTERIA IN WATER, W70-02782	05A
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NW QUADRANGLE, MISSISSIPPI, W70-02662	07C	FLUORIDES	
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASS CHRISTIAN QUADRANGLE, MISSISSIPPI, W70-02663	07C	A FLUOROMETRIC METHOD FOR DETERMINING TRACE QUANTITIES OF FLUORIDE, W70-02726	07B
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NORTH-SOUTH QUADRANGLES, MISSISSIPPI, W70-02664	07C	FLUOROMETRY	
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, VIDALIA QUADRANGLE, MISSISSIPPI, W70-02665	07C	ALGAL GROWTH ASSESSMENTS BY FLUORESCENCE TECHNIQUES, W70-02777	05A
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, WAVELAND-GRAND ISLAND PASS QUADRANGLES, MISSISSIPPI, W70-02666	07C	FORECASTING	
FLOOD PLAIN INFORMATION OF CANANDAIGUA OUTLET IN THE COUNTIES OF ONTARIO AND WAYNE, NEW YORK. W70-02667	04A	ATTAINABLE ACCURACY OF LINEAR STATISTICAL FORECASTING AND OPTIMAL DIMENSIONS OF THE PREDICTOR (RUSSIAN). W70-02656	02B
FLOODWAYS		FORESTS	
FLOOD CONTROL. W70-02575	04A	LEASING STATE FORESTS FOR WATER POWER. W70-02527	06E
FLORIDA		FREEZING	
DEEP WELL DISPOSAL OF WASTEWATERS IN SALINE AQUIFERS OF SOUTH FLORIDA, W70-02468	05E	STALACTITE GROWTH BENEATH SEA ICE, W70-02620	02C
COMBATING SALT-WATER ENCROACHMENT INTO THE BISCAYNE AQUIFER OF MIAMI, FLORIDA, W70-02485	02L	SEASONAL FREEZING AND ITS HYDROLOGICAL EFFECT UNDERR THE CONDITIONS OF THE NORTHERN SLOPE OF THE TRANSILIAN ALA TAU (RUSSIAN). W70-02653	02C
SALT-WATER INTRUSION IN SOUTHEASTERN FLORIDA, W70-02486	02L	FREQUENCY ANALYSIS	
SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK, W70-02631	04C	FREQUENCY ANALYSIS OF RAINFALL INTENSITIES FOR CALCUTTA, W70-02634	02B
FLOTATION		FRESH WATER	
BUOYANCY AND SINKING CHARACTERISTICS OF FRESHWATER PHYTOPLANKTON, W70-02754	05G	FRESHWATER PRIMARY PRODUCTION BY A BLUE-GREEN ALGA OF BACTERIAL SIZE, W70-02508	02B
FLOTSAM		AN INVESTIGATION OF THE STRUCTURAL CHEMISTRY OF YELLOW ORGANIC MATTER IN FRESH WATER, W70-02769	02K
SUSQUEHANNA AND LEHIGH RIVERS AND THEIR TRIBUTARIES, TREES, LUMBER, AND TIMBER THEREIN. W70-02807	06E	FROST ACTION	
FLOW		INVESTIGATION OF SOIL FREEZING, W70-02750	08E
THE INTERPRETATION OF INTERFERENCE TESTS IN NATURALLY FRACTURED RESERVOIRS WITH UNIFORM FRACTURE DISTRIBUTION, W70-02469	08B	FUNGI	
AN INVESTIGATION OF THE FLOW REGIME FOR HELE-SHAW FLOW, W70-02470	08B	AN INVESTIGATION OF THE STRUCTURAL CHEMISTRY OF YELLOW ORGANIC MATTER IN FRESH WATER, W70-02769	02K
FLOW CONTROL		FUSED SALT PLATING	
A STUDY OF FLOW CONDITIONS IN SHAFT SPILLWAYS, W70-02774	08A	EVALUATION OF TITANIUM-PLATED STEEL IN A CHLORIDE ENVIRONMENT, W70-02741	08G
FLOW NETS		GAME PRESERVE	
GROUND WATER SEEPAGE PATTERNS TO WELLS FOR UNCONFINED FLOW, W70-02759	02G	CONSERVATION AND CONTROL OF AQUATIC PLANTS AND FISH. W70-02838	04A
FLUCTUATING TEMPERATURE		GASIFICATION	
EFFECTS OF SIMULTANEOUS VARIATION OF TEMPERATURE AND DISSOLVED OXYGEN ON THE RESISTANCE OF FISHES TO CONTROLLED POLLUTANTS, W70-02731	05C	ANAEROBIC DIGESTION I. THE MICROBIOLOGY OF ANAEROBIC DIGESTION (REVIEW PAPER). W70-02603	05D
FLUCTUATION		GEOCHEMISTRY	
TEMPERATURE FLUCTUATIONS SPECTRA IN THE SEA SURFACE LAYER (RUSSIAN), W70-02647	02L	THERMODYNAMIC MIXING PROPERTIES OF NaCl LIQUIDS, W70-02627	02K
FLUID FRICTION		GEOCHEMISTRY AND ORIGIN OF FORMATION WATERS IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. STABLE ISOTOPES OF HYDROGEN AND OXYGEN, W70-02628	02K
		PARTICULATE ALUMINUM AND IRON IN SEA WATER OFF THE SOUTHEASTERN COAST OF THE UNITED STATES, W70-02630	02K
		GEOMORPHOLOGY	
		GLACIAL DRAINAGE DIVIDE IN THE SKAGIT VALLEY, WASHINGTON, W70-02458	02C
		LATERAL MIGRATION OF THE ARKANSAS RIVER DURING THE QUATERNARY-FOWLER, COLORADO, TO THE COLORADO-KANSAS STATE LINE, W70-02475	02J
		GERMANY	
		BRINE SPRINGS IN THE ZWICKAU-OELSNITZ COAL AREA (GERMAN).	

SUBJECT INDEX

GFR-HUR	
W70-02673	05B
GERMINATION GERMINATION STUDIES OF PERENNIAL GRASS SEEDS, W70-02552	02I
ALKALI SACATON SEEDLINGS AGAR AND SOIL MEDIUM, W70-02685	04A GERMINATION AND SURVIVAL IN AN 04A
GLACIATION GLACIAL DRAINAGE DIVIDE IN THE SKAGIT VALLEY, WASHINGTON, W70-02458	02C
GOLD WESTERN ELECTRIC BUILDS MODERN PLANT FOR TREATING METAL FINISHING WASTES, W70-02601	05D
GOVERNMENT FINANCE FLOOD CONTROL. W70-02576	04A
GRADING CONSTRUCTING BRIDGES TO ELIMINATE GRADE CROSSINGS. W70-02585	06E
GRAIN SIZE RATE AND DIRECTION OF GROUNDWATER CIRCULATION IN CLOSE SPACED BEDROCK AND GRAVEL WELLS UNDER NON-SYNCHRONOUS PUMPING TIME AND RATES, W70-02735	04B
GRAZING THE IMPORTANCE OF PROTOZOA IN CONTROLLING THE ABUNDANCE OF PLANKTONIC ALGAE IN LAKES, W70-02500	02H
GREAT LAKES REGION GREAT LAKES BASIN COMPACT. W70-02540	06B
GROUND COVER ALKALI SACATON SEEDLINGS GERMINATION AND SURVIVAL IN AN AGAR AND SOIL MEDIUM, W70-02685	04A
GROUNDWATER WATER IN THE KAHUKU AREA, OAHU, HAWAII, W70-02623	03B
GEOCHEMISTRY AND ORIGIN OF FORMATION WATERS IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. STABLE ISOTOPES OF HYDROGEN AND OXYGEN, W70-02628	02K
BIG BLACK RIVER, MISSISSIPPI COMPREHENSIVE BASIN STUDY - ANNEX F. GEOLOGY AND WATER RESOURCES, W70-02672	02E
BRINE SPRINGS IN THE ZWICKAU-OELSNITZ COAL AREA (GERMAN), W70-02673	05B
GEOLOGY AND GROUNDWATER RESOURCES OF CASS COUNTY, NORTH DAKOTA PART 3. W70-02675	02F
IRON AND MANGANESE REMOVAL FROM SMALL GROUNDWATER SUPPLIES, W70-02755	05F
GROUNDWATER MOVEMENT ANALYSIS OF INFILTRATION INTO DRAINING POROUS MEDIA, W70-02448	02G
ALFALFA WATER TABLE INVESTIGATIONS, W70-02450	02I
NONLINEAR FLOW IN POROUS MEDIA BY FINITE ELEMENTS, W70-02455	02F
NONLINEAR FLOW IN POROUS MEDIA, W70-02464	02F
MEASURING SUBSURFACE SPRING FLOW WITH RADIOTRACERS, W70-02637	07B
FREE WATER FLOW TO ROWS OF WELLS (RUSSIAN). W70-02657	02F
RELATION OF BEDROCK FRACTURE SYSTEMS TO UNDERGROUND WATER SUPPLIES IN THE STAFFORD SPRINGS, SOUTH CONVENTRY, SPRING HILL, AND WESTFORD QUADRANGLES, W70-02756	02F
GROWTH RATES KINETICS OF NUTRIENT-LIMITED GROWTH, W70-02783	05C
GYPSUM THE EFFECT OF GYPSUM ON THE WATER STORAGE IN A SANDY LOAM SOIL UNDER AN IRRIGATED PERENNIAL PASTURE, W70-02557	02G
HABITATS ALGAE IN RELATION TO MINERAL WATER, W70-02770	05C
HAIL SCATTERING AND ATTENUATION OF RADIATION BY WATER-FILMED HAIL (RUSSIAN), W70-02659	02C
HARBORS WHARVES, DOCKS, HARBORS. W70-02569	03E
HAWAII AN INVESTIGATION OF FLOODS IN HAWAII THROUGH SEPTEMBER 30, 1968, W70-02471	07C
WATER IN THE KAHUKU AREA, OAHU, HAWAII, W70-02623	03B
HAZARDS MINING SAFETY ZONES. W70-02819	06E
HEAT BALANCE THE EFFECT OF THE ADDITION OF HEAT FROM A POWERPLANT ON THE THERMAL STRUCTURE AND EVAPORATION OF LAKE COLCRAD CITY, TEXAS, W70-02703	02D
HEAT DISSIPATION A HYDRAULIC MODEL STUDY OF HEAT DISSIPATION AT KINCARDINE POWER STATION, W70-02717	05B
HEAT EXCHANGE SURFACES EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION, W70-02692	08G
HEAT TRANSFER EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION, W70-02692	08G
USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES, W70-02709	05B
AN EVALUATION OF THE USE OF SELECTIVE DISCHARGES FROM LAKE ROOSEVELT TO COOL THE COLUMBIA RIVER, W70-02739	05B
HEAVE INVESTIGATION OF SOIL FREEZING, W70-02750	08E
HELE-SHAW MODELS AN INVESTIGATION OF THE FLOW REGIME FOR HELE-SHAW FLOW, W70-02470	08B
HERBIVORES THE IMPORTANCE OF PROTOZOA IN CONTROLLING THE ABUNDANCE OF PLANKTONIC ALGAE IN LAKES, W70-02500	02H
HIGHWAY RELOCATION FLOOD CONTROL. W70-02575	04A
HIGHWAYS CONSTRUCTING BRIDGES TO ELIMINATE GRADE CROSSINGS. W70-02585	06E
HORIZONTAL CONDUITS A STUDY OF FLOW CONDITIONS IN SHAFT SPILLWAYS, W70-02774	08A
HUDSON RIVER WATER QUALITY IN INDUSTRIAL AREAS PROFILE OF A RIVER, W70-02493	05C
HUMIC ACID AN INVESTIGATION OF THE STRUCTURAL CHEMISTRY OF YELLOW ORGANIC MATTER IN FRESH WATER, W70-02769	02K
HURRICANE CAMILLE(1969) HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, LOGTOWN QUADRANGLE, MISSISSIPPI, W70-02497	02E
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, ENGLISH LOOKOUT QUADRANGLE, LOUISIANA-MISSISSIPPI, W70-02498	02E
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KILN QUADRANGLE, MISSISSIPPI, W70-02499	02E
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUADRANGLES, MISSISSIPPI-ALABAMA, W70-02660	07C
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BAY ST. LOUIS QUADRANGLE, MISSISSIPPI, W70-02661	07C
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NW QUADRANGLE, MISSISSIPPI, W70-02662	07C
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASS CHRISTIAN QUADRANGLE, MISSISSIPPI, W70-02663	07C
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NORTH-SOUTH QUADRANGLES, MISSISSIPPI, W70-02664	07C
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT	07C

COAST, VIDALIA QUADRANGLE, MISSISSIPPI, W70-02665	07C	PROTON MAGNETIC RESONANCE SPECTRUM OF POLYWATER, W70-02617 01A
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, WAVEYLAND-GRAND ISLAND PASS QUADRANGLES, MISSISSIPPI, W70-02666	07C	HYDROGEOLOGY THE HYDROGEOLOGIC SETTING IN LOS ANGELES COUNTY, CALIFORNIA, W70-02490 02L
HURRICANES HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, LOGTOWN QUADRANGLE, MISSISSIPPI, W70-02497	02E	HYDROGRAPH ANALYSIS DATA ERROR EFFECTS IN UNIT HYDROGRAPH DERIVATION, W70-02454 07A
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, ENGLISH LOOKOUT QUADRANGLE, LOUISIANA-MISSISSIPPI, W70-02498	02E	HYDROGRAPHIC AND SEDIMENTATION SURVEY OF KAJAKAI FESEROVIA, AFGHANISTAN, W70-02669 02J
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KILN QUADRANGLE, MISSISSIPPI, W70-02499	02E	HYDROLOGIC ASPECTS ATTAINABLE ACCURACY OF LINEAR STATISTICAL FORECASTING AND OPTIMAL DIMENSIONS OF THE PREDICTOR (RUSSIAN), W70-02656 02B
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUADRANGLES, MISSISSIPPI-ALABAMA, W70-02660	07C	HYDROLOGIC DATA FORTRAN-HYDRO, W70-02453 07C
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BAY ST. LOUIS QUADRANGLE, MISSISSIPPI, W70-02661	07C	AN INVESTIGATION OF FLOODS IN HAWAII THROUGH SEPTEMBER 30, 1968, W70-02471 07C
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NW QUADRANGLE, MISSISSIPPI, W70-02662	07C	FLOODS IN TRIPLETT CREEK IN VICINITY OF MOREHEAD, KENTUCKY, W70-02496 02E
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASS CHRISTIAN QUADRANGLE, MISSISSIPPI, W70-02663	07C	HYDROLOGIC PROPERTIES INDIRECT EVALUATION OF SOME CHARACTERISTICS OF A HYDROLOGICAL REGIME OF RIVERS UNDER CONDITIONS OF EXCESSIVE MOISTURE (RUSSIAN), W70-02482 02A
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NORTH-SOUTH QUADRANGLES, MISSISSIPPI, W70-02664	07C	SEASONAL FREEZING AND ITS HYDROLOGICAL EFFECT UNDER THE CONDITIONS OF THE NORTHERN SLOPE OF THE TRANSILIAN ALA TAU (RUSSIAN), W70-02653 02C
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, VIDALIA QUADRANGLE, MISSISSIPPI, W70-02665	07C	HYDROLYSIS ANAEROBIC DIGESTION I. THE MICROBIOLOGY OF ANAEFCBIC DIGESTION (REVIEW PAPER), W70-02603 05D
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, WAVEYLAND-GRAND ISLAND PASS QUADRANGLES, MISSISSIPPI, W70-02666	07C	HYPOLIMNION COOLING WATER STUDIES AT ELECTRIC POWER STATION, W70-02713 05B
HYDRAULIC CONDUCTIVITY THE EFFECT OF GYPSUM ON THE WATER STORAGE IN A SANDY LOAM SOIL UNDER AN IRRIGATED PERENNIAL PASTURE, W70-02557	02G	THE CELITERATION OF THE HYPOLIMNION, W70-02797 05C
FACTORS DETERMINING THE HYDRAULIC CONDUCTIVITY OF RED MEDITERRANIAN SOILS AND DERIVED TYPES, W70-02558	02G	ICE JAMS RIVER ICE JAMS - A LITERATURE REVIEW, W70-02494 02C
HYDRAULIC JUMP FLUCTUATING PRESSURES IN SPILLWAY STILLING BASINS, W70-02457	08B	ILLINOIS CLAIMS AGAINST AND CONTRACTS WITH OTHER DISTRICTS AND MUNICIPAL CORPORATIONS EXERCISING DRAINAGE POWERS, W70-02516 04A
HYDRAULIC MODELS FLUCTUATING PRESSURES IN SPILLWAY STILLING BASINS, W70-02457	08B	IMPOUNDED WATERS THE LAW OF SURFACE WATER IN MISSOURI, W70-02583 04A
AN INVESTIGATION OF THE FLOW REGIME FOR BELE-SHAW FLOW, W70-02870	08B	IMPOUNDED RELEASES IMPOUNDED INFLUENCES ON WATER QUALITY, W70-02785 05G
SCALING PROCEDURES FOR MOBILE BED HYDRAULIC MODELS IN TERMS OF SIMILITUDE THEORY, W70-02473	02J	IMPOUNDMENTS IMPOUNDMENT INFLUENCES ON WATER QUALITY, W70-02785 05G
AIR ENTRAINMENT BY FLOWING WATER UNDER REDUCED ATMOSPHERIC PRESSURE, W70-02474	02E	INCINERATION SLUDGE DISPOSAL EXPERIENCES AT NORTH LITTLE ROCK, ARKANSAS, W70-02616 05D
THE TRANSFORMATION OF A SOLITARY WAVE OVER AN UNEVEN BOTTOM, W70-02625	02L	INCLINED-SHAFT SPILLWAYS A STUDY OF FLOW CONDITIONS IN SHAFT SPILLWAYS, W70-02774 08A
CONSIDERATIONS ON HYDRAULIC MODELS TO BE EMPLOYED TO STUDY RECIRCULATION INTAKE CONDITIONS OF COOLING WATER IN STEAM POWER STATIONS, W70-02707	05B	INCOME ANALYSIS OPERATIONS RESEARCH STUDY OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT OF THE TUCSON BASIN, W70-02680 06A
USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES, W70-02709	05B	INDIA STUDIES IN THE TECHNIQUES OF FIELD TRIALS IN RANGE LANDS I. SIZE, SHAPE AND ARRANGEMENT OF PLOTS, W70-02551 03P
A HYDRAULIC MODEL STUDY OF HEAT DISSIPATION AT KINCARDINE POWER STATION, W70-02717	05B	PHOTOSOCIOLOGICAL VARIATIONS IN FLORISTIC COMPOSITION OF THE VEGETATION IN THE ARID ZONE I. MONSOONAL VEGETATION OF THE ALLUVIAL PLAINS, W70-02553 02I
HYDRAULIC SIMILITUDE SCALING PROCEDURES FOR MOBILE BED HYDRAULIC MODELS IN TERMS OF SIMILITUDE THEORY, W70-02473	02J	STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GROWTH AND FORAGE PRODUCTION OF DHAMAN (CENCHRUS CILIARIS) AND SEWAN (LASIURUS SINDICUS) PASTURES IN THE ESTABLISHMENT YEAR, W70-02554 03F
CONSIDERATIONS ON HYDRAULIC MODELS TO BE EMPLOYED TO STUDY RECIRCULATION INTAKE CONDITIONS OF COOLING WATER IN STEAM POWER STATIONS, W70-02707	05B	INDUSTRIAL WASTES INDUSTRIAL WASTES, W70-02548 06E
HYDROCARBONS MODERN HYDROCARBONS IN TWO WISCONSIN LAKES, W70-02509	02H	WESTERN ELECTRIC BUILDS MODERN PLANT FOR TREATING METAL FINISHING WASTES, W70-02601 05D
HYDRODYNAMICS SOME EXPERIENCE IN THE STUDY OF THE DYNAMICS OF A BENTHONIC WATER LAYER IN THE NEAR-SHORE ZONE OF RESERVOIRS (RUSSIAN), W70-02483	02H	
HYDROGEN BONDING		

THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTES, W70-02614	05D	OHIO RIVER VALLEY SANITATION COMPACT. W70-02571	05G
INFILTRATION INFILTRATION OF WATER INTO NONUNIFORM SOIL. W70-02447	02G	DELAWARE RIVER BRIDGE COMPACT. W70-02813	06E
ANALYSIS OF INFILTRATION INTO DRAINING POROUS MEDIA, W70-02448	02G	INTERSTATE RIVERS DELAWARE RIVER BRIDGES. W70-02546	04A
INHIBITION THE EFFECT OF METHANE ANALOGUES ON METHANOGENESIS IN ANAEROBIC DIGESTION, W70-02595	05D	INTERSTATE WATERS REGULATION OF HUNTING AND FISHING IN INTERSTATE WATERS. W70-02502	06E
INHIBITORS SALT WATER CORROSION CONTROL BY ENVIRONMENT MODIFICATION, W70-02689	08G	INVESTIGATEES MEASURING ORGANIC MATTER RETAINED BY AQUATIC INVESTIGATEES, W70-02790	05C
INJECTION WELLS DEEP WELL DISPOSAL OF WASTEWATERS IN SALINE AQUIFERS OF SOUTH FLORIDA, W70-02468	05E	INVESTIGATIONS REFORESTATION SURVEY. W70-02532	04D
THE CHALLENGE OF WATER MANAGEMENT ORANGE COUNTY WATER DISTRICT, CALIFORNIA, W70-02489	02L	IODIDE ION A FLUOROMETRIC DETERMINATION OF IODIDE ION, W70-02727	07B
THE AMELIORATION OR PREVENTION OF SALT-WATER INTRUSION IN AQUIFERS - EXPERIENCE IN LOS ANGELES COUNTY, CALIFORNIA, W70-02491	02L	ION EXCHANGE ANALYSIS OF TRACE ELEMENTS IN WATER. W70-02768	05A
INJUNCTION(PROHIBITORY) INTERSTATE COMMERCE - NAVIGABLE RIVERS - INDUSTRIAL WASTE CLOGGING CHANNEL HELD NOT UNLAWFUL OBSTRUCTION - UNITED STATES V REPUBLIC STEEL CORP (7TH CIR 1959). W70-02512	05G	IOWS A FLUOROMETRIC METHOD FOR DETERMINING TRACE QUANTITIES OF FLUORIDE, W70-02726	07B
INLAND WATERS REGULATION OF HUNTING AND FISHING IN INTERSTATE WATERS. W70-02502	06E	A FLUOROMETRIC DETERMINATION OF IODIDE ION, W70-02727	07B
INLAND WATERWAYS INLAND WATERWAY TRANSPORTATION, STUDIES IN PUBLIC AND PRIVATE MANAGEMENT AND INVESTMENT DECISIONS, W70-02700	06B	FLUOROMETRIC DETERMINATION OF OXALATE ION, W70-02728	07B
INPUT-OUTPUT ANALYSIS THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA, W70-02479	03F	IONS(SULFIDE) PHOSPHORUS BUDGETS OF LAKES SIDNEY LANIER AND HARTWELL, GEORGIA, W70-02752	05G
INSECTICIDES EFFECTS OF CHLORINATED HYDROCARBON INSECTICIDES ON THE FRESHWATER SEED SERVING, W70-02679	05C	ION-EXCHANGE STUDY OF A DESIGN-OPTIMIZATION PROCEDURE FOR ION-EXCHANGE AND ADSORPTION COLUMNS, W70-02667	03A
INSTITUTIONS DELAWARE RIVER BASIN COMMISSION ANNUAL REPORT 1969. W70-02694	05G	AXIAL-DISPERSION CONSTANT-PATTERN KINETICS OF ION-EXCHANGE AND ADSORPTION COLUMNS, W70-02688	03A
INSTRUMENTATION A FALLING-PARTICLE CURRENT METER, W70-02670	07B	IOWA REGULATION OF DAM AND MILLWAY CONSTRUCTION AND OPERATION. W70-02570	04A
INTERGOVERNMENTAL COOPERATION POLLUTION OF WATERS. W70-02538	05G	IRON EFFECT OF YELLOW ORGANIC ACIDS ON IRON AND OTHER METALS IN WATER, W70-02505	02K
INTERSTATE DELAWARE RIVER BASIN COMMISSION ANNUAL REPORT 1969. W70-02694	05G	PARTICULATE ALUMINUM AND IRON IN SEA WATER OFF THE SOUTHEASTERN COAST OF THE UNITED STATES, W70-02630	02K
INTERSTATE COMMISSIONS POTOMAC RIVER POLLUTION. W70-02535	05G	PHOSPHORUS BUDGETS OF LAKES SIDNEY LANIER AND HARTWELL, GEORGIA, W70-02752	05G
OHIO RIVER VALLEY WATER SANITATION COMPACT. W70-02539	05G	IRON AND MANGANESE REMOVAL FROM SMALL GROUNDWATER SUPPLIES, W70-02755	05F
GREAT LAKES BASIN COMPACT. W70-02540	06B	IRON ALLOYS DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02693	08G
DELAWARE RIVER BRIDGES. W70-02546	04A	W70-02742	08G
DELAWARE RIVER JOINT TOLL BRIDGE COMMISSION. W70-02547	04A	IRON-BASE ALLOYS DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02742	08G
TRANSFER OF POWERS. W70-02830	06E	IRRIGATED LAND EXPRESSING IRRIGATION EFFICIENCY IN TERMS OF APPLICATION TIME, INTAKE AND WATER ADVANCE CONSTANTS, W70-02556	03F
INTERSTATE COMPACTS POTOMAC RIVER POLLUTION. W70-02535	05G	SOIL FORMATION AND SALT MIGRATION IN THE SORGAB RIVER DELTA, W70-02565	02G
OHIO RIVER VALLEY WATER SANITATION COMPACT. W70-02579	05G	IRRIGATION INFILTRATION OF WATER INTO NONUNIFORM SOIL, W70-02487	02G
BRANDYWINE RIVER VALLEY COMPACT. W70-02581	06B	THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA, W70-02479	03F
MISCELLANEOUS PROVISIONS (RELATING TO WATER).		A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967, W70-02495	06B
		IRRIGATION IN ARID LANDS, W70-02559	03F

THE MAJARDAH SCHEME, W70-02560	03F	LABORATORY WATERSHED DETERMINATION OF FLOWS FOR UNGAGED STREAMS, W70-02748	02A
VALUE OF DESALTED WATER FOR IRRIGATION, W70-02632	03C	LAKE DRUMMOND A PRELIMINARY ECOLOGICAL SURVEY OF THE WATER RESOURCES AND LAND USE PATTERNS OF THE DISMAL SWAMP AREA OF VIRGINIA, W70-02746	06G
SOME EXPERIENCE IN THE DEVELOPMENT OF LAND IN THE NEW IRRIGATION ZONE IN THE GOLODNOVAYA STEPPE (RUSSIAN), W70-02648	03F	LAKE HARTWELL(GA) PHOSPHORUS BUDGETS OF LAKES SIDNEY LANIER AND HARTWELL, GEORGIA, W70-02752	05G
IRRIGATION ECONOMICS THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA, W70-02479	03F	LAKE MENDOTA(WIS) REPORT ON THE NUTRIENT SOURCES OF LAKE MENDOTA, W70-02506	05B
IRRIGATION EFFICIENCY EXPRESSING IRRIGATION EFFICIENCY IN TERMS OF APPLICATION TIME, INTAKE AND WATER ADVANCE CONSTANTS, W70-02556	03F	SEDIMENTARY PHOSPHORUS IN LAKE CORES--OBSERVATIONS ON DEPOSITIONAL PATTERN IN LAKE MENDOTA, W70-02800	02H
THE EFFECT OF GYPSUM ON THE WATER STORAGE IN A SANDY LOAM SOIL UNDER AN IRRIGATED PERENNIAL PASTURE, W70-02557	02G	LAKE PONTCHARTRAIN PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA, W70-02766	05C
WATER REQUIREMENTS OF LAWNGRASS, W70-02562	02D	LAKE SEDIMENTS SEDIMENTARY PHOSPHORUS IN LAKE CORES--OBSERVATIONS ON DEPOSITIONAL PATTERN IN LAKE MENDOTA, W70-02800	02H
DETERMINATIONS OF LEAF AND FRUIT WATER POTENTIAL WITH A PRESSURE CHAMBER, W70-02568	02I	LAKE SIDNEY LANIER(GA) PHOSPHORUS BUDGETS OF LAKES SIDNEY LANIER AND HARTWELL, GEORGIA, W70-02752	05G
IRRIGATION WATER SPRINKLER IRRIGATION SPRAY TEMPERATURES, W70-02563	03F	LAKE SOILS LAKE TYPES AND LAKE SEDIMENTS, W70-02683	02H
ISRAEL FACTORS DETERMINING THE HYDRAULIC CONDUCTIVITY OF RED MEDITERRANEAN SOILS AND DERIVED TYPES, W70-02558	02G	LAKE TYPOLOGY LAKE TYPES AND LAKE SEDIMENTS, W70-02683	02H
MULTIPLE USE OF MEDITERRANEAN RANGE LANDS NEW APPROACHES TO OLD PROBLEMS, W70-02567	03F	ON THE RELATION BETWEEN THE OXYGEN DEFICIT AND THE PRODUCTIVITY AND TYPOLOGY OF LAKES, W70-02799	02H
JETS JETS WITH NEGATIVE BUOYANCY IN HOMOGENEOUS FLUID, W70-02715	02E	LAKES DENSITY STRATIFIED LAKES IN NORTHERN ELLESmere ISLAND, W70-02446	02H
JUDICIAL DECISIONS THE LAW OF SURFACE WATER IN MISSOURI, W70-02580	04A	THE IMPORTANCE OF PROTOZOA IN CONTROLLING THE ABUNANCE OF PLANKTOMIC ALGAE IN LAKES, W70-02500	02H
JURISDICTION RIVERS LAKES NAVIGABLE WATERS STATE JURISDICTION. W70-02840	06E	BREPORT ON THE NUTRIENT SOURCES OF LAKE MENDOTA, W70-02506	05B
JURISDICTION OF COUNTIES ON BOUNDARY WATERS. W70-02841	06E	MODERN HYDROCARBONS IN TWO WISCONSIN LAKES, W70-02509	02H
KAHUKU(HAWAII) WATER IN THE KAHUKU AREA, OAHU, HAWAII, W70-02623	03B	A LIMNOLOGICAL COMPARISON OF TWELVE LARGE LAKES IN NORTHERN SASKATCHEWAN, W70-02511	02H
KANSAS THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA, W70-02479	03F	MOUNTAIN AND DESERT LAKES IN SOUTHERN KAZAKHSTAN, THEIR RESOURCES AND METHODS OF ECONOMIC DEVELOPMENT, W70-02564	02H
KARA-KUM DESERT SOIL FORMATION AND SALT MIGRATION IN THE MURGAB RIVER DELTA, W70-02565	02G	NUTRIENT LIMITATION OF SUMMER PHYTOPLANKTON GROWTH IN CAYUGA LAKE, W70-02643	05C
KAZAKHSTAN MOUNTAIN AND DESERT LAKES IN SOUTHERN KAZAKHSTAN, THEIR RESOURCES AND METHODS OF ECONOMIC DEVELOPMENT, W70-02564	02H	LAKE TYPES AND LAKE SEDIMENTS, W70-02683	02H
KENTUCKY FLOODS IN TRIPLETT CREEK IN VICINITY OF MOREHEAD, KENTUCKY, W70-02496	02E	THE EFFECT OF THE ADDITION OF HEAT FROM A POWERPLANT ON THE THERMAL STRUCTURE AND EVAPORATION OF LAKE COLORADO CITY, TEXAS, W70-02703	02D
OHIO RIVER VALLEY SANITATION COMPACT. W70-02571	05G	CLADOCERAN FAUNAS ASSOCIATED WITH AQUATIC MACROPHYTES IN SOME LAKES IN NORTHWESTERN MINNESOTA, W70-02289	02H
KINETIC THEORY KINETICS OF NUTRIENT-LIMITED GROWTH, W70-02783	05C	THE OBLITERATION OF THE HYPOLIMNION, W70-02797	05C
KINETICS KINETICS OF NUTRIENT-LIMITED GROWTH, W70-02783	05C	SOME PHYSICAL AND CHEMICAL FACTORS IN THE METABOLISM OF LAKES, W70-02790	02H
KRAFT WASTE TREATMENT OF KRAFT MILL WASTES WITH A PLASTIC MEDIA TRICKLING FILTER, W70-02606	05D	ON THE RELATION BETWEEN THE OXYGEN DEFICIT AND THE PRODUCTIVITY AND TYPOLOGY OF LAKES, W70-02799	02H
LABORATORIES STRUCTURAL CHARACTERISTICS OF BENTHIC ALgal COMMUNITIES IN LABORATORY STREAMS, W70-02780	05C	SEDIMENTARY PHOSPHORUS IN LAKE CORES--OBSERVATIONS ON DEPOSITIONAL PATTERN IN LAKE MENDOTA, W70-02800	02H
SOME EFFECTS OF CURRENT VELOCITY ON PERiphyton COMMUNITIES IN LABORATORY STREAMS, W70-02794	05C	SEDIMENTARY PHOSPHORUS IN LAKE CORES--ANALYTICAL PROCEDURE, W70-02801	05A
LABORATORY TESTS COLLICULAR ARAGONITE AND QUARTZ SAND LABORATORY COMPARISON UNDER WAVE ACTION, W70-02624	08E	EUTROPHICATION AND SENESCENCE IN A GROUP OF PRAIRIE-PARKLAND LAKES IN ALBERTA, CANADA, W70-02802	05C
LA MAR COUNTY WATER FOR INDUSTRIAL DEVELOPMENT IN COVINGTON, JEFFERSON			

SUBJECT INDEX

LAM-MAT

DAVIS, LAMAR, LAWRENCE, MARION, AND WALTHALL COUNTIES, MISSISSIPPI, W70-02478	03E	LOWLAND VEGETATION MEASUREMENT OF EVAPOTRANSPIRATION IN LOWLAND VEGETATION, W70-02733	02D
LAND DEVELOPMENT PETITION TO COURT FOR DRAINAGE AND APPOINTMENT OF COMMISSIONERS. W70-02520	04A	LUMBER TAKING UP DRIFTING LUMBER. W70-02806	06E
SOME EXPERIENCE IN THE DEVELOPMENT OF LAND IN THE NEW IRRIGATION ZONE IN THE GOLODNOYAY STEPPE (RUSSIAN), W70-02648	03F	FLOATING LUMBER ON THE DELAWARE RIVER. W70-02826	06E
LAND MANAGEMENT A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967, W70-02495	06B	LUMBERING REGISTRATION AND ADOPTION OF 'MARK' AS IDENTIFICATION OF LUMBER UPON THE ALLEGHENY RIVER. W70-02528	06E
LAND RECLAMATION SOIL FORMATION AND SALT MIGRATION IN THE MURGAB RIVER DELTA, W70-02565	02G	SUSQUEHANNA AND LEHIGH RIVERS AND THEIR TRIBUTARIES, TREES, LUMBER, AND TIMBER THEREIN. W70-02807	06E
SOME EXPERIENCE IN THE DEVELOPMENT OF LAND IN THE NEW IRRIGATION ZONE IN THE GOLODNOYAY STEPPE (RUSSIAN), W70-02648	03F	FLOATING LUMBER ON THE DELAWARE RIVER. W70-02826	06E
LAND TENURE THE MAJARDAH SCHEME, W70-02560	03F	MACROPHYTES CLADOCERAN FAUNAS ASSOCIATED WITH AQUATIC MACROPHYTES IN SOME LAKES IN NORTHWESTERN MINNESOTA, W70-02789	02H
LAND USE MULTIPLE USE OF MEDITERRANEAN RANGE LANDS NEW APPROACHES TO OLD PROBLEMS, W70-02567	03F	MAINTENANCE ENGINEERING ASPECTS OF WASTEWATER CONTRACTS, W70-02605	05D
LAWNS WATER REQUIREMENTS OF LAWNGRASS, . W70-02562	02D	MAJARDAH BASIN THE MAJARDAH SCHEME, W70-02560	03F
LEAD EFFECTS OF SIMULTANEOUS VARIATION OF TEMPERATURE AND DISSOLVED OXYGEN ON THE RESISTANCE OF FISHES TO CONTROLLED POLLUTANTS, W70-02731	05C	MAMMALIAN CELLS BIOASSAY OF WATER POLLUTANTS WITH CULTURED MAMMALIAN CELLS, W70-02771	05A
LEASES LEASING STATE FORESTS FOR WATER POWER. W70-02527	06E	MANAGEMENT ENGINEERING ASPECTS OF WASTEWATER CONTRACTS, W70-02605	05D
TOWN CONTROL OF FISHERIES. W70-02592	06E	SUITABILITY OF THE UPPER COLORADO RIVER BASIN FOR PRECIPITATION MANAGEMENT, W70-02622	03B
LEASING OF TOLL BRIDGES. W70-02805	06E	MANGANESE IRON AND MANGANESE REMOVAL FROM SMALL GROUNDWATER SUPPLIES, W70-02755	05F
LEGAL ASPECTS LEGAL AND ECONOMIC ASPECTS OF SALT-WATER ENCROACHMENT INTO COASTAL AQUIFERS, W70-02492	02L	MARINE ANIMALS PHOSPHORUS EXCRETION AND BODY SIZE IN MARINE ANIMALS MICROZOOPHYTON AND NUTRIENT REGENERATION, W70-02791	05C
THE LAW OF SURFACE WATER IN MISSOURI. W70-02577	04A	MARINE MICROORGANISMS ENUMERATION OF AUTOTROPHIC AMMONIUM-OXIDIZING BACTERIA IN MARINE WATERS BY A DIRECT METHOD, W70-02507	07B
LEGUMES STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GROWTH AND FORAGE PRODUCTION OF DHAMAN (CENCHRUS CLARISS) AND SEVEN (LASIURUS SINDICUS) PASTURES IN THE ESTABLISHMENT YEAR, W70-02554	03F	MARINE RAILWAY POWERS OF THE DEPARTMENT OF RESOURCE DEVELOPMENT. W70-02842	04A
LIMITING FACTORS ALGAE IN RELATION TO MINE WATER, W70-02770	05C	MARYLAND BAER V BD OF COUNTY COMM'R'S OF WASHINGTON COUNTY. W70-02517	04C
LIMNOLOGY A LIMNOLOGICAL COMPARISON OF TWELVE LARGE LAKES IN NORTHERN SASKATCHEWAN, W70-02511	02H	MASS TRANSFER EXPERIMENTAL PROBLEMS ASSOCIATED WITH THE TESTING OF SURFACE AERATION EQUIPMENT, W70-02612	05D
PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA, W70-02766	05C	MATHEMATICAL MODEL DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE SIMULATION OF FLATLAND WATERSHED HYDRAULICS, W70-02676	02G
LIQUEFACTION ANAEROBIC DIGESTION I. THE MICROBIOLOGY OF ANAEROBIC DIGESTION (REVIEW PAPER), W70-02603	05D	MATHEMATICAL MODELS NONLINEAR FLOW IN POROUS MEDIA BY FINITE ELEMENTS, W70-02455	02F
LIQUIDS THERMODYNAMIC MIXING PROPERTIES OF NaCl LIQUIDS, W70-02627	02K	COORDINATION IN MOBILE-BED HYDRAULICS, W70-02463	06B
LOADS FLOOD CONTROL. W70-02576	04A	URBAN RUNOFF BY ROAD RESEARCH LABORATORY METHOD, W70-02467	04C
LOCAL GOVERNMENTS LEASING OF TOLL BRIDGES. W70-02805	06E	THE INTERPRETATION OF INTERFERENCE TESTS IN NATURALLY FRACTURED RESERVOIRS WITH UNIFORM FRACTURE DISTRIBUTION, W70-02469	08B
MUNICIPAL ASSISTANCE. W70-02808	06E	THE TRANSFORMATION OF A SOLITARY WAVE OVER AN UNEVEN BOTTOM, W70-02625	02L
LOS ANGELES COUNTY(CALIF.) THE AMELIORATION OR PREVENTION OF SALT-WATER INTRUSION IN AQUIFERS - EXPERIENCE IN LOS ANGELES COUNTY, CALIFORNIA, W70-02491	02L	GRAVITY WAVES OVER A NON-UNIFORM FLOW, W70-02626	02L
LOTIC ENVIRONMENT SOME FACTORS AFFECTING RESPIRATION OF PERiphyton COMMUNITIES IN LOTIC ENVIRONMENTS, W70-02781	05C	STOCHASTIC BASIS FOR COMPREHENSIVE RIVER BASIN PLANNING PHASE I, W70-02681	06A
MATHEMATICAL STUDIES THEORETICAL BASEFLOW CURVES, W70-02460	02A	MATHEMATICAL STUDIES THEORETICAL BASEFLOW CURVES, W70-02460	02A
FREE WATER FLOW TO ROWS OF HILLS (RUSSIAN), W70-02657	02F	FREE WATER FLOW TO ROWS OF HILLS (RUSSIAN), W70-02657	02F

DETERMINATION OF SPACINGS OF PARALLEL DRAINAGE SECTIONS AND FILTER-WELL SERIES IN OPENCAST MINE DRAINAGES (GERMAN), W70-02674	05G	MINE DRAINAGE DETERMINATION OF SPACINGS OF PARALLEL DRAINAGE SECTIONS AND FILTER-WELL SERIES IN OPENCAST MINE DRAINAGES (GERMAN), W70-02674	05G
MEANDERS LATERAL MIGRATIONS OF THE ARKANSAS RIVER DURING THE QUATERNARY-FOWLER, COLORADO, TO THE COLORADO-KANSAS STATE LINE, W70-02475	02J	MINING MINING SAFETY ZONES. W70-02819	06E
MEDITERRANEAN CLIMATE THE MAJARDAH SCHEME, W70-02560	03F	MINES AND MINING. W70-02820	05G
MULTIPLE USE OF MEDITERRANEAN RANGE LANDS NEW APPROACHES TO OLD PROBLEMS, W70-02567	03F	MINNESOTA CLADOCERAN FAUNAS ASSOCIATED WITH AQUATIC MACROPHYTES IN SOME LAKES IN NORTHWESTERN MINNESOTA, W70-02789	02H
MESOPHILIC-THERMOPHILIC TREATMENT OF KRAFT MILL WASTES WITH A PLASTIC MEDIA TRICKLING FILTER, W70-02606	05D	MISSISSIPPI FLOODS OF JUNE 1, 1967 IN SOUTHWESTERN JACKSON, MISSISSIPPI, W70-02477	02E
METABOLISM ENERGY CONCEPTS OF AEROBIC MICROBIAL METABOLISM, W70-02613	05D	WATER FOR INDUSTRIAL DEVELOPMENT IN COVINGTON, JEFFERSON DAVIS, LAMAR, LAWRENCE, MARION, AND WALTHALL COUNTIES, MISSISSIPPI, W70-02478	03E
SOME PHYSICAL AND CHEMICAL FACTORS IN THE METABOLISM OF LAKES, W70-02798	02H	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, LOGTOWN QUADRANGLE, MISSISSIPPI, W70-02497	02E
METAL PLATING WASTES WESTERN ELECTRIC BUILDS MODERN PLANT FOR TREATING METAL FINISHING WASTES, W70-02601	05D	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, ENGLISH LOOKOUT QUADRANGLE, LOUISIANA-MISSISSIPPI, W70-02498	02E
METALLIC IONS EFFECT OF YELLOW ORGANIC ACIDS ON IRON AND OTHER METALS IN WATER, W70-02505	02K	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KILN QUADRANGLE, MISSISSIPPI, W70-02499	02E
METALS LEAD AND OTHER METAL IONS IN UNITED STATES PRECIPITATION, W70-02444	05B	POWER, RIGHTS, AND PRIVILEGES OF RAILROAD CORPORATIONS TO CROSS WATERCOURSES. W70-02572	04A
EFFECT OF YELLOW ORGANIC ACIDS ON IRON AND OTHER METALS IN WATER, W70-02505	02K	FLOOD CONTROL. W70-02573	04A
METEORITES RESULTS OF ATMOSPHERIC CIRCULATION STUDIES OVER EUROPE, ASIA, AND THE ARCTIC BY RADAR-METEOR TECHNIQUE (RUSSIAN), W70-02655	02B	FLOODS IN MISSISSIPPI-SEPTEMBER 1965 THROUGH SEPTEMBER 1967, W70-02621	02E
METEOROLOGY ATTAINABLE ACCURACY OF LINEAR STATISTICAL FORECASTING AND OPTIMAL DIMENSIONS OF THE PREDICTOR (RUSSIAN), W70-02656	02B	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUADRANGLES, MISSISSIPPI-ALABAMA, W70-02660	07C
LOCAL MOISTURE AND PRECIPITATION, W70-02668	02B	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BAY ST. LOUIS QUADRANGLE, MISSISSIPPI, W70-02661	07C
METHANE FERMENTATION THE METHANE FERMENTATION BETWEEN MESOPHILIC AND THERMOPHILIC TEMPERATURE RANGES, W70-02597	05D	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASS CHRISTIAN QUADRANGLE, MISSISSIPPI, W70-02663	07C
METHANOGENESIS THE EFFECT OF METHANE ANALOGUES ON METHANOGENESIS IN ANAEROBIC DIGESTION, W70-02595	05D	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NORTH-SOUTH QUADRANGLES, MISSISSIPPI, W70-02664	07C
METHODOLOGY ENUMERATION OF AUTOTROPHIC AMMONIUM-OXIDIZING BACTERIA IN MARINE WATERS BY A DIRECT METHOD, W70-02507	07B	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, VIDALIA QUADRANGLE, MISSISSIPPI, W70-02665	07C
MICHIGAN PREVENTION OF POLLUTION. W70-02514	05G	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, WAVELAND-GRAND ISLAND PASS QUADRANGLES, MISSISSIPPI, W70-02666	07C
MICROBIAL DEGRADATION STUDIES ON PHOSPHOROUS TRANSFORMATIONS IN EUTROPHIC LAKES, W70-02747	05C	BIG BLACK RIVER, MISSISSIPPI COMPREHENSIVE BASIN STUDY - ANNEX F. GEOLOGY AND WATER RESOURCES, W70-02672	02E
MICROBIAL GROWTH KINETICS OF NUTRIENT-LIMITED GROWTH, W70-02783	05C	MISSOURI THE LAW OF SURFACE WATER IN MISSOURI, W70-02577	04A
MICROBIOLOGY ENERGY CONCEPTS OF AEROBIC MICROBIAL METABOLISM, W70-02613	05D	W70-02578	04A
MICROMeteorology SPRINKLER IRRIGATION SPRAY TEMPERATURES, W70-02563	03F	W70-02579	04A
MICROORGANISMS PHOSPHORUS EXCRETION AND BODY SIZE IN MARINE ANIMALS MICROZOOPHYTON AND NUTRIENT REGENERATION, W70-02791	05C	W70-02580	04A
MILL DAMS MILL DAMS. W70-02586	06E	W70-02581	04A
MILLS MILL DAMS. W70-02586	06E	W70-02582	04A
		W70-02583	04A
		MIXING THERMAL DISCHARGES FROM LARGE NUCLEAR PLANT, W70-02635	05B
		MODEL STUDIES MOVEMENT OF SAND IN TUNNELS, W70-02465	08B
		SCALING PROCEDURES FOR MOBILE BED HYDRAULIC MODELS IN TERMS OF SIMILITUDE THEORY, W70-02473	02J
		COMPARISON OF WIND WAVE AND UNIFORM WAVE EFFECTS ON A BEACH, W70-02476	02L

SUBJECT INDEX

MOD-NUC

A HYDRAULIC MODEL STUDY OF HEAT DISSIPATION AT KINCARDINE POWER STATION, W70-02717 05B

GENERALIZED ANALYSIS OF SMALL WATERSHED RESPONSES, W70-02763 02A

MODEL TESTS DESIGN PRINCIPLES OF WASTE STABILIZATION PONDS, W70-02609 05D

MOLLUSCICIDES CORRELATION OF STRUCTURE VS ACTIVITY OF POLLUTANTS OF FRESH WATER, W70-02753 05C

MOREHEAD(KY) FLOODS IN TRIPLETT CREEK IN VICINITY OF MOREHEAD, KENTUCKY, W70-02496 02E

MOUNTAINS A METHOD FOR THE DETERMINATION OF SNOW RESOURCES IN A MOUNTAIN BASIN (RUSSIAN), W70-02649 02C

SOME EXPERIENCE IN EVALUATION OF ATMOSPHERIC PRECIPITATIONS IN THE MOUNTAINS OF TRANSILIAN ALA TAU (RUSSIAN), W70-02650 02B

TOTAL SUMMER EVAPORATION IN THE CENTRAL MOUNTAIN BELT OF TRANSILIAN ALATAU AND THE EFFECT OF SLOPE EXPOSURE ON EVAPORATION (RUSSIAN), W70-02651 02D

SEASONAL FREEZING AND ITS HYDROLOGICAL EFFECT UNDER THE CONDITIONS OF THE NORTHERN SLOPE OF THE TRANSILIAN ALA TAU (RUSSIAN), W70-02653 02C

MULTIPLE PURPOSE MOUNTAIN AND DESERT LAKES IN SOUTHERN KAZAKHSTAN, THEIR RESOURCES AND METHODS OF ECONOMIC DEVELOPMENT, W70-02564 02H

MULTIPLE PURPOSE PROJECTS MULTIPLE USE OF MEDITERRANEAN RANGE LANDS NEW APPROACHES TO OLD PROBLEMS, W70-02567 03F

MUNICIPAL CORPORATIONS THE LAW OF SURFACE WATER IN MISSOURI, W70-02582 04A

MUNICIPAL WASTES THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTES, W70-02614 05D

MURGAB RIVER DELTA SOIL FORMATION AND SALT MIGRATION IN THE MURGAB RIVER DELTA, W70-02565 02G

NaCl-KCl LIQUIDS THERMODYNAMICS THERMODYNAMIC MIXING PROPERTIES OF NaCl LIQUIDS, W70-02627 02K

PLANKTON PRIMARY PRODUCTION BY A BLUE-GREEN ALGA OF BACTERIAL SIZE, W70-02508 02H

NATIONAL RIVERS AND HARBORS CONGRESS REMARKS BY CONGRESSMAN WILLIAM C. CRAMER BEFORE THE 56TH ANNUAL CONVENTION, NATIONAL RIVERS AND HARBORS CONGRESS, W70-02513 05G

NATURAL RECHARGE OPTIMIZING SALVAGEABLE WATER RESOURCES IN A SEMI-ARID INLAND BASIN, W70-02745 03C

NATURAL RESOURCES MOUNTAIN AND DESERT LAKES IN SOUTHERN KAZAKHSTAN, THEIR RESOURCES AND METHODS OF ECONOMIC DEVELOPMENT, W70-02564 02H

DEPARTMENT OF NATURAL RESOURCES, W70-02584 06E

CONSERVATION OF NATURAL RESOURCES, W70-02587 03D

NAVIGABLE RIVERS INTERSTATE COMMERCE - NAVIGABLE RIVERS - INDUSTRIAL WASTE CLOGGING CHANNEL HELD NOT UNLAWFUL OBSTRUCTION - UNITED STATES V REPUBLIC STEEL CORP (7TH CIR 1959), W70-02512 05G

STREAM BOUNDARIES, W70-02523 06E

POWER OF BOARD OF COMMISSIONERS OF NAVIGATION TO LICENSE PILOTS, W70-02817 06E

RIGHT TO RUN TUNNEL UNDER RIVER TO COAL MINE, W70-02818 06E

NAVIGABLE WATERS BRIDGES OVER NAVIGABLE WATERWAYS AND RAILROADS, W70-02811 06E

RIVERS LAKES NAVIGABLE WATERS STATE JURISDICTION, W70-02840 06E

NAVIGATION INTERSTATE COMMERCE - NAVIGABLE RIVERS - INDUSTRIAL WASTE CLOGGING CHANNEL HELD NOT UNLAWFUL OBSTRUCTION - UNITED STATES V REPUBLIC STEEL CORP (7TH CIR 1959), W70-02512 05G

NETHERLANDS A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967, W70-02495 06E

NETS ARTIFICIAL PROPAGATION LICENSES AND SEINE LICENSES, W70-02831 06E

NEUSE RIVER CURRENT STUDY IN THE NEUSE RIVER AND ESTUARY OF NORTH CAROLINA, W70-02760 02L

NEW JERSEY DELAWARE RIVER JOINT TOLL BRIDGE COMMISSION, W70-02547 04A

STATE V ARCHER, W70-02834 04D

NEW YORK PROTECTING LONG ISLAND AQUIFERS AGAINST SALT-WATER INTRUSION, W70-02488 02L

FLOOD PLAIN INFORMATION OF SCAUAQUADA CREEK, IN THE TOWNS OF CHEKTOWAGA AND LANCASTER, ERIE COUNTY, NEW YORK, W70-02629 04A

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN NEW YORK, W70-02645 04A

FLOOD PLAIN INFORMATION OF CANANDAIGUA OUTLET IN THE COUNTIES OF ONTARIO AND WAYNE, NEW YORK, W70-02667 04A

NEWFOUND LAKE PHYTOPLANKTON FLORA OF NEWFOUND AND WINNISQUA LAKES, NEW HAMPSHIRE, W70-02764 05C

NITRATES NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- III. DENITRIFICATION IN THE MODIFIED ACTIVATED SLUDGE PROCESS, W70-02607 05D

NITRIFICATION ENUMERATION OF AUTOTROPHIC AMMONIUM-OXIDIZING BACTERIA IN MARINE WATERS BY A DIRECT METHOD, W70-02507 07B

NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- II. NITRIFICATION IN TRICKLING FILTERS, W70-02604 05D

NITROGEN NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- III. DENITRIFICATION IN THE MODIFIED ACTIVATED SLUDGE PROCESS, W70-02607 05D

SOLUBILITIES OF NITROGEN, OXYGEN, AND ARGON IN DISTILLED WATER, W70-02701 02K

CONTRIBUTIONS TO THE KNOWLEDGE OF NITROGENOUS COMPOUNDS AND PHOSPHATE IN THE LAKE WATERS OF JAPAN, W70-02788 05C

NUTRIENT-PHYTOPLANKTON RELATIONSHIPS IN EIGHT SOUTHERN ONTARIO LAKES, W70-02795 05C

NONLINEAR FLOW(POROUS MEDIA) NONLINEAR FLOW IN POROUS MEDIA, W70-02464 02F

NORTH DAKOTA GEOLOGY AND GROUNDWATER RESOURCES OF CASS COUNTY, NORTH DAKOTA PART 3, W70-02675 02F

NUCLEAR FUEL ANALYSIS OF TRACE ELEMENTS IN WATER, W70-02768 05A

NUCLEAR MAGNETIC RESONANCE PROTON MAGNETIC RESONANCE SPECTRUM OF POLY(ATE), W70-02617 01A

POLYWATER PROTON NUCLEAR MAGNETIC RESONANCE SPECTRUM, W70-02618 02A

NUCLEAR POWERPLANTS THERMAL DISCHARGES FROM LARGE NUCLEAR PLANT, W70-02635 05B

NUCLEATION SITE EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION,

W70-02692	08G	ORANGE COUNTY(CALIF) PLANNING AND PROVIDING AN ADEQUATE SUPPLY OF WATER FOR ORANGE COUNTY, CALIFORNIA, W70-02487	02L
NUISANCE ALGAE OBJECTIONABLE ALGAE WITH REFERENCE TO THE KILLING OF FISH AND OTHER ANIMALS, W70-02803	05C	THE CHALLENGE OF WATER MANAGEMENT IN ORANGE COUNTY WATER DISTRICT, CALIFORNIA, W70-02489	02L
NUTRIENT LIMITED GROWTH KINETICS OF NUTRIENT-LIMITED GROWTH, W70-02783	05C	ORGANIC ACIDS EFFECT OF YELLOW ORGANIC ACIDS ON IRON AND OTHER METALS IN WATER, W70-02505	02K
NUTRIENT REQUIREMENTS EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES, W70-02792	05C	ORGANIC ACIDS(YELLOW) EFFECT OF YELLOW ORGANIC ACIDS ON IRON AND OTHER METALS IN WATER, W70-02505	02K
MINERAL NUTRITION OF PHYTOPLANKTON, W70-02804	05C	ORGANIC COMPOUNDS RESPIRATION CORRECTIONS FOR BACTERIAL UPTAKE OF DISSOLVED ORGANIC COMPOUNDS IN NATURAL WATERS, W70-02641	05A
NUTRIENT SOURCES REPORT ON THE NUTRIENT SOURCES OF LAKE MENDOTA. W70-02506	05B	ORGANIC MATTER INTERRELATIONS OF DISSOLVED ORGANIC MATTER AND PHYTOPLANKTON, W70-02510	05C
NUTRIENTS NUTRIENT LIMITATION OF SUMMER PHYTOPLANKTON GROWTH IN CAYUGA LAKE, W70-02643	05C	MEASURING ORGANIC MATTER RETAINED BY AQUATIC INVERTEBRATES, W70-02790	05C
KINETICS OF NUTRIENT-LIMITED GROWTH, W70-02783	05C	ORGANIC NUTRIENTS PHOSPHORUS BUDGETS OF LAKES SIDNEY LANIER AND HARTWELL, GEORGIA, W70-02752	05G
CONTRIBUTIONS TO THE KNOWLEDGE OF NITROGENOUS COMPOUNDS AND PHOSPHATE IN THE LAKE WATERS OF JAPAN, W70-02788	05C	OSMOTIC PRESSURE EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS. VI EFFECTS OF THE EXTERNAL OSMOTIC WATER POTENTIAL ON SOLUTE REQUIREMENT, SALT TRANSPORT KINETICS AND GROWTH RATES OF LEAVES, W70-02566	02I
PHOSPHORUS EXCRETION AND BODY SIZE IN MARINE ANIMALS MICROZOOPHANCKTON AND NUTRIENT REGENERATION, W70-02791	05C	OSTRACODS EFFECTS OF CHLORINATED HYDROCARBON INSECTICIDES ON THE FRESHWATER SEED SHRIMP, W70-02679	05C
NUTRIENT-PHYTOPLANKTON RELATIONSHIPS IN EIGHT SOUTHERN ONTARIO LAKES, W70-02795	05C	OUTLETS DISCHARGE OF SEWAGE ON OR WITHIN LIMITS OF HIGHWAY. W70-02545	06E
OBSTRUCTION TO FLOW INTERFERENCE WITH DRAINAGE FACILITIES. W70-02526	04A	OXALATE ION FLUOROMETRIC DETERMINATION OF OXALATE ION, W70-02728	07B
STREAM CLEARANCE, RECTIFICATION AND IMPROVEMENT. W70-02827	04A	OXIDATION CHEMISTRY OF THE OXIDANT, FERRATE, ITS INTERACTION WITH SPECIFIC ORGANICS FOUND IN WASTE WATER, W70-02738	05G
OBSTRUCTION TO NAVIGATION MILL DAMS. W70-02586	06E	IRON AND MANGANESE REMOVAL FROM SMALL GROUNDWATER SUPPLIES, W70-02755	05F
OCEAN CURRENTS A FALLING-PARTICLE CURRENT METER, W70-02670	07B	OXYGEN SOLUBILITIES OF NITROGEN, OXYGEN, AND ARGON IN DISTILLED WATER, W70-02701	02K
OCEANS DISCHARGE OF SEWAGE EFFLUENT FROM A LINE SOURCE INTO A STRATIFIED OCEAN, W70-02714	05D	OXIGEST KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION, W70-02611	05D
OIL SPILLAGE STUDY OF EQUIPMENT AND METHODS FOR REMOVING OIL FROM HARBOR WATERS. W70-02725	05G	OXYGEN ON THE RELATION BETWEEN THE OXYGEN DEFICIT AND THE PRODUCTIVITY AND TYPOLOGY OF LAKES, W70-02799	02H
OIL WASTES STUDY OF EQUIPMENT AND METHODS FOR REMOVING OIL FROM HARBOR WATERS. W70-02725	05G	OXYGEN DEFICIT ON THE RELATION BETWEEN THE OXYGEN DEFICIT AND THE PRODUCTIVITY AND TYPOLOGY OF LAKES, W70-02799	02H
ON-SITE TESTS COOLING WATER STUDIES AT ELECTRIC POWER STATION, W70-02713	05B	OXYGEN UPTAKE INHIBITIONS CORRELATION OF STRUCTURE VS ACTIVITY OF POLLUTANTS OF FRESH WATER, W70-02753	05C
ONTARIO NUTRIENT-PHYTOPLANKTON RELATIONSHIPS IN EIGHT SOUTHERN ONTARIO LAKES, W70-02795	05C	OXYGENATION EXPERIMENTAL PROBLEMS ASSOCIATED WITH THE TESTING OF SURFACE AERATION EQUIPMENT, W70-02612	05D
ON-SITE INVESTIGATIONS STUDIES IN THE TECHNIQUES OF FIELD TRIALS IN RANGE LANDS I. SIZE, SHAPE AND ARRANGEMENT OF PLOTS, W70-02551	03F	OYSTERS MISCELLANEOUS PROVISIONS (RELATING TO WATER). W70-02544	05G
OOLITIC ARAGONITE OOLITIC ARAGONITE AND QUARTZ SAND LABORATORY COMPARISON UNDER WAVE ACTION, W70-02624	08E	FISH AND GAME OYSTER GROUND LEASES. W70-02591	06E
OPEN CHANNEL FLOW OPEN-CHANNEL SURGE SIMULATION BY DIGITAL COMPUTER, W70-02459	08B	PACKAGE PLANT KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION, W70-02611	05D
COORDINATION IN MOBILE-BED HYDRAULICS, W70-02463	08B	PARTICLE SHAPE SIMULTANEOUS DETERMINATION OF BASIC GEOMETRICAL CHARACTERISTICS OF POROUS MEDIA, W70-02466	08G
FLOW BELOW DEEPLY SUBMERGED RECTANGULAR WEIRS, W70-02472	02E	PARTICLE SIZE SIMULTANEOUS DETERMINATION OF BASIC GEOMETRICAL	
OPERATING DATA PHOSPHATE REMOVAL AT FORT WORTH, TEXAS, W70-02596	05D		
OPERATIONS RESEARCH OPERATIONS RESEARCH STUDY OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT OF THE TUCSON BASIN, W70-02680	06A		

CHARACTERISTICS OF POROUS MEDIA.	08G	PETTY POLLUTION.	05G
W70-02466		W70-02549	
PENALTIES(CRIMINAL)		DOMESTIC WATER SUPPLIES.	05F
POLLUTION OF DRINKING WATER.	05P	W70-02550	
W70-02522		WHARVES, DOCKS, HARBORS.	06E
DISCHARGE OF SEWAGE ON OR WITHIN LIMITS OF HIGHWAY.		W70-02569	
W70-02545	06E	CONSTRUCTING BRIDGES TO ELIMINATE GRADE CROSSINGS.	06E
FISH AND GAME OYSTER GROUND LEASES.	06E	W70-02585	
W70-02591		HILL DAMS.	06E
PENNSYLVANIA		W70-02586	
WATER CONSERVATION AND RECLAMATION FUND.	05G	WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF	
W70-02518		ENGINEERS IN PENNSYLVANIA.	
UNLAWFUL ENTRY UPON RESERVOIRS, PONDS, AND DAMS.	06E	W70-02648	08A
W70-02519		LEASING OF TOLL BRIDGES.	
PETITION TO COURT FOR DRAINAGE AND APPOINTMENT OF		W70-02805	06E
COMMISSIONERS.		TAKING UP DRIFTING LUMBER.	
W70-02520	04A	W70-02806	06E
SOIL CONSERVATION POLICY.	08D	SUSQUEHANNA AND LEHIGH RIVERS AND THEIR TRIBUTARIES, TREES,	
W70-02521		LUMBER, AND TIMBER THEREIN.	
POLLUTION OF DRINKING WATER.	05F	W70-02807	06E
W70-02522		MUNICIPAL ASSISTANCE.	
STREAM BOUNDARIES.	06E	W70-02808	06E
W70-02523		FISHING REGULATIONS APPLYING TO BOUNDARY RIVERS.	
CITIES' POWER OVER WATERCOURSES.	04A	W70-02809	06E
W70-02524		DAMS, FISHWAYS, BAR-RACKS, OBSTRUCTIONS.	
CITIES OF THE SECOND CLASS POWERS RELATING TO LEVEES,		W70-02810	06E
FERRIES, WHARVES, CHANNELS, PIERS, AND INFLUENT PIPES.		BRIDGES OVER NAVIGABLE WATERWAYS AND RAILROADS.	
W70-02525	04A	W70-02811	06E
INTERFERENCE WITH DRAINAGE FACILITIES.		AUTHORITY TO ERECT BRIDGES.	
W70-02526	04A	W70-02812	06E
LEASING STATE FORESTS FOR WATER POWER.		DELAWARE RIVER BRIDGE COMPACT.	
W70-02527	06E	W70-02813	06E
REGISTRATION AND ADOPTION OF 'MARK' AS IDENTIFICATION OF		DELAWARE RIVER TUNNEL AND BRIDGE.	
LUMBER UPON THE ALLEGHENY RIVER.		W70-02814	06E
W70-02528	06E	POWER OF BOARD OF COMMISSIONERS OF NAVIGATION TO LICENSE	
APPROPRIATION AND CONDEMNATION OF LANDS AND WATERS TO ENABLE		PILOTS.	
COMPLETION OF AUTHORIZED PROJECTS.		W70-02817	06E
W70-02529	06E	RIGHT TO RUN TUNNEL UNDER RIVER TO COAL MINE.	
UNDERGROUND WATER DEVELOPMENT.		W70-02818	06E
W70-02530	06E	MINING SAFETY ZONES.	
FLOOD CONTROL.		W70-02819	06E
W70-02531	04A	MINES AND MINING.	
REFORESTATION SURVEY.		W70-02820	05G
W70-02532	04D	PREVENTION OF FLOOD DAMAGE.	
UNITED STATES PROJECTS.		W70-02821	04A
W70-02533	06E	WHARVES, DOCKS, AND FERRIES.	
OBSTRUCTIONS NOT TO BE MADE OR ALTERED WITHOUT CONSENT.		W70-02822	04A
W70-02534	04A	WHARF LINES AT BRISTOL.	
POTOMAC RIVER POLLUTION.		W70-02823	04A
W70-02535	05G	BIDS RECONSTRUCTION OF DESTROYED BRIDGES.	
PYRATOWMING SWAMP DAM.		W70-02824	04A
W70-02536	04A	COUNTY'S RIGHT OF ENTRY FOR CONSTRUCTION.	
LOCATION AND IMPROVEMENT OF RIVERS AND STREAMS.		W70-02825	06E
W70-02537	04A	FLOATING LUMBER ON THE DELAWARE RIVER.	
POLLUTION OF WATERS.		W70-02826	06E
W70-02538	05G	STREAM CLEARANCE, RECTIFICATION AND IMPROVEMENT.	
OHIO RIVER VALLEY WATER SANITATION COMPACT.		W70-02827	08A
W70-02539	05G	SCHUYLKILL RIVER POLLUTION.	
GRATI LAKES BASIN COMPACT.		W70-02828	05G
W70-02540	06B	DAMS AND STORAGE RESERVOIR.	
BRANDYWINE RIVER VALLEY COMPACT.		W70-02829	04A
W70-02541	06B	TRANSFER OF POWERS.	
PENNSYLVANIA FISHING REGULATIONS APPLYING TO INLAND WATERS		W70-02830	06E
AND BOUNDARY LAKES.		ARTIFICIAL PROPAGATION LICENSES AND SEINE LICENSES.	
W70-02542	06E	W70-02831	06E
POLLUTION TRESPASS ON STATE HATCHERIES.		CLEAN STREAMS LAW.	
W70-02543	05G	W70-02832	05G
MISCELLANEOUS PROVISIONS (RELATING TO WATER).		SEWAGE POLLUTION.	
W70-02544	05G	W70-02833	05G
DISCHARGE OF SEWAGE ON OR WITHIN LIMITS OF HIGHWAY.		PERENNIAL GRASSES	
W70-02545	06E	GERMINATION STUDIES OF PERENNIAL GRASS SEEDS,	
DELaware RIVER BRIDGES.		W70-02552	02I
W70-02546	04A	PERENNIAL PLANTS	
DELWARE RIVER JOINT TOLL BRIDGE COMMISSION.		PHYSOTOCIOLOGICAL VARIATIONS IN FLORISTIC COMPOSITION OF THE	
W70-02547	06A	VEGETATION IN THE ARID ZONE I. MONSOONAL VEGETATION OF	
INDUSTRIAL WASTES.		THE ALLUVIAL PLAINS,	
W70-02548	06E		

W70-02553	02I	
PERFORMANCE PRELIMINARY DESIGN OF WASTEWATER TREATMENT SYSTEMS, W70-02610	05D	
PERIPHYTON SOME FACTORS AFFECTING RESPIRATION OF PERIPHYTON COMMUNITIES IN LOTIC ENVIRONMENTS, W70-02781	05C	
SOME EFFECTS OF CURRENT VELOCITY ON PERIPHYTON COMMUNITIES IN LABORATORY STREAMS, W70-02794	05C	
PERMEABILITY SIMULTANEOUS DETERMINATION OF BASIC GEOMETRICAL CHARACTERISTICS OF POROUS MEDIA, W70-02966	08G	
THE INTERPRETATION OF INTERFERENCE TESTS IN NATURALLY FRACTURED RESERVOIRS WITH UNIFORM FRACTURE DISTRIBUTION, W70-02469	08B	
PERMITS REGULATION OF HUNTING AND FISHING IN INTERSTATE WATERS. W70-02502	06E	
INTERFERENCE WITH DRAINAGE FACILITIES. W70-02526	04A	
REGULATION OF DAM AND MILLWAY CONSTRUCTION AND OPERATION. W70-02570	04A	
FISHING LICENSES. W70-02598	06E	
FISHING BY NON-RESIDENTS. W70-02732	06E	
FISH AND GAME. W70-02815	06E	
POWER OF BOARD OF COMMISSIONERS OF NAVIGATION TO LICENSE PILOTS. W70-02817	06E	
ARTIFICIAL PROPAGATION LICENSES AND SEINE LICENSES. W70-02831	06E	
WILDLIFE CONSERVATION. W70-02835	06E	
FISH AND GAME. W70-02837	06E	
PESTICIDE RESIDUES INTERACTION OF PESTICIDE POLLUTANTS AND AQUATIC FOOD-CHAIN ORGANISMS, W70-02677	05C	
PESTICIDE TOXICITY EFFECTS OF CHLORINATED HYDROCARBON INSECTICIDES ON THE FRESHWATER SEED SHRIMP, W70-02679	05C	
PESTICIDES INFLUENCE OF pH ON THE ADSORPTION OF AROMATIC ACIDS ON ACTIVATED CARBON, W70-02843	05G	
INTERACTION OF INORGANIC AND ORGANIC FERTILIZER MATERIALS WITH PESTICIDES AS RELATED TO WATER QUALITY IN SOILS, W70-02761	05B	
PESTICIDE RESIDUES THE ECOLOGY OF THE YOUNG FISHES OF THE NEWBRITAIN RIVER ESTUARY, W70-02678	05C	
PHOSPHATE STUDIES STUDIES ON PHOSPHOROUS TRANSFORMATIONS IN EUTROPHIC LAKES, W70-02747	05C	
PHOSPHATE REMOVAL PHOSPHATE REMOVAL AT FORT WORTH, TEXAS, W70-02596	05D	
PHOSPHORUS PHOSPHORUS BUDGETS OF LAKES SIDNEY LANIER AND HARTWELL, GEORGIA, W70-02752	05G	
CONTRIBUTIONS TO THE KNOWLEDGE OF NITROGENOUS COMPOUNDS AND PHOSPHATE IN THE LAKE WATERS OF JAPAN, W70-02788	05C	
PHOSPHORUS EXCRETION AND BODY SIZE IN MARINE ANIMALS MICROZOOPHANCKTON AND NUTRIENT REGENERATION, W70-02791	05C	
NUTRIENT-PHYTOPLANKTON RELATIONSHIPS IN EIGHT SOUTHERN ONTARIO LAKES, W70-02795	05C	
SEDIMENTARY PHOSPHORUS IN LAKE CORES--OBSERVATIONS ON DEPOSITIONAL PATTERN IN LAKE MENDOTA, W70-02800	02H	
SEDIMENTARY PHOSPHORUS IN LAKE CORES--ANALYTICAL PROCEDURE, W70-02801	05A	
PHOSPHORUS RADIOISOTOPES SIMULTANEOUS DETERMINATION OF ZN-65-30 AND P-32-15 IN SHELLFISH BY RADIOCHEMICAL TECHNIQUES, W70-02796	05A	
PHOTOSYNTHESIS THE MECHANISM OF PHOTOSYNTHESIS, W70-02503	02K	
EXTRACELLULAR PRODUCTS OF PHYTOPLANKTON PHOTOSYNTHESIS, W70-02504	05B	
PHYSICAL FACTORS SOME PHYSICAL AND CHEMICAL FACTORS IN THE METABOLISM OF LAKES, W70-02798	02H	
PHYTOPLANKTON EXTRACELLULAR PRODUCTS OF PHYTOPLANKTON PHOTOSYNTHESIS, W70-02504	05B	
INTERRELATIONS OF DISSOLVED ORGANIC MATTER AND PHYTOPLANKTON, W70-02510	05C	
NUTRIENT LIMITATION OF SUMMER PHYTOPLANKTON GROWTH IN CAYUGA LAKE, W70-02643	05C	
BUOYANCY AND SINKING CHARACTERISTICS OF FRESHWATER PHYTOPLANKTON, W70-02754	05G	
PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA, W70-02766	05C	
NUTRIENT-PHYTOPLANKTON RELATIONSHIPS IN EIGHT SOUTHERN ONTARIO LAKES, W70-02795	05C	
MINERAL NUTRITION OF PHYTOPLANKTON, W70-02804	05C	
PIERS LOCAL SCOUR AROUND BRIDGE PIERS, W70-02462	08B	
CITIES OF THE SECOND CLASS POWERS RELATING TO LEVEES, FERRIES, WHARVES, CHANNELS, PIERS, AND INFLUENT PIPES. W70-02525	04A	
PINE FOREST MEASUREMENT OF EVAPOTRANSPIRATION IN LOWLAND VEGETATION, W70-02733	02D	
PISCICULTURE POWERS OF THE DEPARTMENT OF RESOURCE DEVELOPMENT. W70-02842	04A	
PITTING RESISTANCE DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02693	08G	
PLANT GROWTH PHOTOSOCIOLOGICAL VARIATIONS IN FLORISTIC COMPOSITION OF THE VEGETATION IN THE ARID ZONE I. MONSOONAL VEGETATION OF THE ALLUVIAL PLAINS, W70-02553	02I	
EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS. VI. EFFECTS OF THE EXTERNAL OSMOTIC WATER POTENTIAL ON SOLUTE REQUIREMENT, SALT TRANSPORT KINETICS AND GROWTH RATES OF LEAVES, W70-02566	02I	
PLANT PHYSIOLOGY DETERMINATIONS OF LEAF AND FRUIT WATER POTENTIAL WITH A PRESSURE CHAMBER, W70-02568	02I	
PLANT POPULATIONS PHOTOSOCIOLOGICAL VARIATIONS IN FLORISTIC COMPOSITION OF THE VEGETATION IN THE ARID ZONE I. MONSOONAL VEGETATION OF THE ALLUVIAL PLAINS, W70-02553	02I	
PLANT TISSUES DETERMINATIONS OF LEAF AND FRUIT WATER POTENTIAL WITH A PRESSURE CHAMBER, W70-02568	02I	
PLANT UPSET STABILIZATION OF AN ACTIVATED SLUDGE PLANT, W70-02593	05D	
PLASTIC COVERS DOMES PROTECT TRICKLING FILTERS, W70-02615	05D	
PLASTIC MEDIA TREATMENT OF KRAFT MILL WASTES WITH A PLASTIC MEDIA TRICKLING FILTER, W70-02606	05D	
PLASTICS DOMES PROTECT TRICKLING FILTERS, W70-02615	05D	

SUBJECT INDEX

PLA-RAD		
PLATED LOW-CARBON STEELS		THE ROLE OF SOLID AND LIQUID PRECIPITATIONS IN RUNCOPF FORMATION (RUSSIAN), W70-02654
EVALUATION OF TITANIUM-PLATED STEEL IN A CHLORIDE ENVIRONMENT, W70-02741	08G	02C
PLEISTOCENE EPOCH		LOCAL MOISTURE AND PRECIPITATION, W70-02668
GLACIAL DRAINAGE DIVIDE IN THE SKAGIT VALLEY, WASHINGTON, W70-02458	02C	02B
PLUMES		PRESSURE CHAMBER DETERMINATIONS OF LEAF AND FRUIT WATER POTENTIAL WITH A PRESSURE CHAMBER, W70-02568
DISCHARGE OF SEWAGE EFFLUENT FROM A LINE SOURCE INTO A STRATIFIED OCEAN, W70-02714	05D	02I
POLITICAL ASPECTS		PRICING OPERATIONS RESEARCH STUDY OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT OF THE TUCSON BASIN, W70-02680
REMARKS BY CONGRESSMAN WILLIAM C. CRAMER BEFORE THE 56TH ANNUAL CONVENTION, NATIONAL RIVERS AND HARBORS CONGRESS. W70-02513	05G	06A
POLLUTANTS		PRIMARY PRODUCTIVITY PRESWATER PRIMARY PRODUCTION BY A BLUE-GREEN ALGA OF BACTERIAL SIZE, W70-02508
BIOASSAY OF WATER POLLUTANTS WITH CULTURED MAMMALIAN CELLS, W70-02771	05A	02H
EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES, W70-02792	05C	05D
POLLUTED DISCHARGE		PRIMARY SLUDGE SLUDGE DISPOSAL EXPERIENCES AT NORTH LITTLE ROCK, ARKANSAS, W70-02616
HYDROBIOLOGICAL CONTROL OF THE TREATMENT OF WASTE WATERS IN ACCUMULATION PONDS (CZECH), W70-02793	05B	02I
POLLUTION		PRODUCTIVITY STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GROWTH AND FORAGE PRODUCTION OF DHARAN (<i>CENCHRUS CILIARIS</i>) AND SENNA (<i>LASIOSIUS SINDICUS</i>) PASTURES IN THE ESTABLISHMENT YEAR, W70-02554
ANALYSIS OF TRACE ELEMENTS IN WATER, W70-02768	05A	03F
POLLUTION ABATEMENT		IRRIGATION IN ARID LANDS, W70-02559
PREVENTION OF POLLUTION. W70-02514	05G	02F
EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING, AND PREVENTING POLLUTION, B-166506, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION. W70-02743	05G	02E
HYDROBIOLOGICAL CONTROL OF THE TREATMENT OF WASTE WATERS IN ACCUMULATION PONDS (CZECH), W70-02793	05B	05C
POLLUTION CONTROL		LIMITATION OF ALgal GROWTH IN SOME CENTRAL AFRICAN WATERS, W70-02646
CLEANING OUR ENVIRONMENT - THE CHEMICAL BASIS FOR ACTION, W70-02640	05G	05B
PONDS		ON THE RELATION BETWEEN THE OXYGEN DEFICIT AND THE PRODUCTIVITY AND TYPOLOGY OF LAKES, W70-02799
HYDROBIOLOGICAL CONTROL OF THE TREATMENT OF WASTE WATERS IN ACCUMULATION PONDS (CZECH), W70-02793	05B	02B
POROSITY		PROJECT PLANNING FLOOD CONTROL. W70-02573
SIMULTANEOUS DETERMINATION OF BASIC GEOMETRICAL CHARACTERISTICS OF POROUS MEDIA, W70-02466	08G	05A
POROUS MEDIA		W70-02574
NONLINEAR FLOW IN POROUS MEDIA, W70-02464	02F	05A
SIMULTANEOUS DETERMINATION OF BASIC GEOMETRICAL CHARACTERISTICS OF POROUS MEDIA, W70-02466	08G	05A
THE INTERPRETATION OF INTERFERENCE TESTS IN NATURALLY FRACTURED RESERVOIRS WITH UNIFORM FRACTURE DISTRIBUTION, W70-02469	08B	05D
AN INVESTIGATION OF THE FLOW REGIME FOR HELE-SHAH FLOW, W70-02470	08B	02E
POTABLE WATER		PROTOZOA THE IMPORTANCE OF PROTOZOA IN CONTROLLING THE ABUNDEANCE OF PLANKTOMIC ALGAE IN LAKES, W70-02500
POLLUTION OF DRINKING WATER. W70-02522	05F	02H
POTASSIUM COMPOUNDS		PSEUDONONAS ECOLOGY OF SELECTED AQUATIC BACTERIA IN THE SNAKE RIVER, W70-02762
THERMODYNAMIC MIXING PROPERTIES OF NaCl LIQUIDS, W70-02627	02K	05C
POWER GROWTH SURVEYS		PUBLIC ACCESS PUBLIC LANDS AND SWAMPS - SALES - PUBLIC USE. W70-02586
PLANNING FOR POWER - A LOOK AT TOMORROWS STATION SIZES, W70-02740	08C	05A
PRECIPITABLE WATER		PUBLIC POLICY SOIL CONSERVATION POLICY. W70-02521
LOCAL MOISTURE AND PRECIPITATION, W70-02668	02B	04D
PRECIPITATION MANAGEMENT		PUBLIC RIGHTS PUBLIC LANDS AND SWAMPS - SALES - PUBLIC USE. W70-02588
SUITABILITY OF THE UPPER COLORADO RIVER BASIN FOR PRECIPITATION MANAGEMENT, W70-02622	03B	04A
PRECIPITATION(Atmospheric)		PUBLIC UTILITIES APPROPRIATION AND CONDEMNATION OF LANDS AND WATERS TO ENABLE COMPLETION OF AUTHORIZED PROJECTS. W70-02529
LEAD AND OTHER METAL IONS IN UNITED STATES PRECIPITATION, W70-02644	05B	06E
SUITABILITY OF THE UPPER COLORADO RIVER BASIN FOR PRECIPITATION MANAGEMENT, W70-02622	03B	08E
SOME EXPERIENCE IN EVALUATION OF ATMOSPHERIC PRECIPITATIONS IN THE MOUNTAINS OF TRANSILIAN ALA TAU (RUSSIAN). W70-02650	02B	RADIATION SCATTERING AND ATTENUATION OF RADIATION BY WATER-FILLED HAIL (RUSSIAN), W70-02659
RADIOACTIVITY EFFECTS		02C
THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTES, W70-02674	05D	RADIOCHEMICAL ANALYSIS RESPIRATION CORRECTIONS FOR BACTERIAL UPTAKE OF DISSOLVED ORGANIC COMPOUNDS IN NATURAL WATERS,

W70-02641	05A	EXPERIMENTAL PROBLEMS ASSOCIATED WITH THE TESTING OF SURFACE AERATION EQUIPMENT, W70-02612	05D
SIMULTANEOUS DETERMINATION OF ZN-65-30 AND P-32-15 IN SHELLFISH BY RADIOCHEMICAL TECHNIQUES, W70-02796	05A	AERATION MEASUREMENTS IN AN ESTUARY, W70-02636	05G
RADIOISOTOPES INTERPRETATION OF RADIONUCLIDE UPTAKE FROM AQUATIC ENVIRONMENTS, W70-02786	05A	REGENERATION RATE EXPERIMENTAL PROBLEMS ASSOCIATED WITH THE TESTING OF SURFACE AERATION EQUIPMENT, W70-02612	05D
RAILROADS POWERS, RIGHTS, AND PRIVILEGES OF RAILROAD CORPORATIONS TO CROSS WATERCOURSES. W70-02572	04A	RECOVERY EQUIPMENT COMBATING POLLUTION CREATED BY OIL SPILLS, VOLUME I METHODS, W70-02744	05G
THE LAW OF SURFACE WATER IN MISSOURI, W70-02582	04A	REGENERATION PHOSPHORUS EXCRETION AND BODY SIZE IN MARINE ANIMALS MICROZOOPLANKTON AND NUTRIENT REGENERATION, W70-02791	05C
BRIDGES OVER NAVIGABLE WATERWAYS AND RAILROADS. W70-02811	06E	REGENERATION CYCLE STUDY OF A DESIGN-OPTIMIZATION PROCEDURE FOR ION-EXCHANGE AND ADSORPTION COLUMNS, W70-02687	03A
BRIDGES MADE SAFE. W70-02839	06E	REGULATED FLOW PYMATUNING SWAMP DAM. W70-02536	04A
PAIN THE ROLE OF SOLID AND LIQUID PRECIPITATIONS IN RUNOFF FORMATION (RUSSIAN), W70-02654	02C	REGULATION REGULATION OF HUNTING AND FISHING IN INTERSTATE WATERS. W70-02502	06E
RAINBOW TROUT INFLUENCE OF STARVATION ON SELECTED TEMPERATURE OF SOME SALMONIDS, W70-02706	05C	REGISTRATION AND ADOPTION OF 'MARK' AS IDENTIFICATION OF LUMBER UPON THE ALLEGHENY RIVER. W70-02528	06E
RAINFALL FLOODS IN MISSISSIPPI-SEPTEMBER 1965 THROUGH SEPTEMBER 1967. W70-02621	02E	PETTY POLLUTION. W70-02549	05G
RAINFALL DISPOSITION FREQUENCY ANALYSIS OF RAINFALL INTENSITIES FOR CALCUTTA, W70-02634	02B	FISH AND GAME LAWS - GENERAL PROVISIONS. W70-02589	06E
RAINFALL INTENSITY FLOODS OF JUNE 1, 1967 IN SOUTHWESTERN JACKSON, MISSISSIPPI, W70-02477	02E	VIGILANCE OVER RESERVOIRS. W70-02639	06E
RAINFALL-RUNOFF RELATIONSHIPS DATA ERROR EFFECTS IN UNIT HYDROGRAPH DERIVATION, W70-02454	07A	WILDLIFE CONSERVATION. W70-02835	06E
GENERALIZED ANALYSIS OF SMALL WATERSHED RESPONSES, W70-02763	02A	CONSERVATION AND CONTROL OF AQUATIC PLANTS AND FISH. W70-02838	04A
RAJASTHAN GERMINATION STUDIES OF PERENNIAL GRASS SEEDS, W70-02552	02I	RELATIVE RIGHTS BAER V BD OF COUNTY COMM'R'S OF WASHINGTON COUNTY. W70-02517	04C
STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GROWTH AND FORAGE PRODUCTION OF DHAMAN (CENCHRUS CILIARIS) AND SEWAN (LASIURUS SINDICUS) PASTURES IN THE ESTABLISHMENT YEAR, W70-02554	03F	REPULSION(LEGAL ASPECTS) THE LAW OF SURFACE WATER IN MISSOURI, W70-02579	04A
RANGE GRASSES STUDIES IN THE TECHNIQUES OF FIELD TRIALS IN RANGE LANDS I. SIZE, SHAPE AND ARRANGEMENT OF PLOTS, W70-02551	03F	W70-02580	04A
GERMINATION STUDIES OF PERENNIAL GRASS SEEDS, W70-02552	02I	W70-02581	04A
RANGE MANAGEMENT STUDIES IN THE TECHNIQUES OF FIELD TRIALS IN RANGE LANDS I. SIZE, SHAPE AND ARRANGEMENT OF PLOTS, W70-02551	03F	W70-02583	04A
STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GROWTH AND FORAGE PRODUCTION OF DHAMAN (CENCHRUS CILIARIS) AND SEWAN (LASIURUS SINDICUS) PASTURES IN THE ESTABLISHMENT YEAR, W70-02554	03F	RESEARCH AND DEVELOPMENT A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967, W70-02495	06B
MULTIPLE USE OF MEDITERRANEAN RANGE LANDS NEW APPROACHES TO OLD PROBLEMS, W70-02567	03F	STUDIES IN THE TECHNIQUES OF FIELD TRIALS IN RANGE LANDS I. SIZE, SHAPE AND ARRANGEMENT OF PLOTS, W70-02551	03F
ALKALI SACATON SEEDLINGS GERMINATION AND SURVIVAL IN AN AGAR AND SOIL MEDIUM, W70-02685	04A	COMBATING POLLUTION CREATED BY OIL SPILLS, VOLUME I METHODS, W70-02744	05G
RANGE REHABILITATION GERMINATION STUDIES OF PERENNIAL GRASS SEEDS, W70-02552	02I	RESEEDING RANGE SEEDING PROBLEMS AND RESEARCH IN THE PINYON-JUNIPER WOODLAND TYPE OF SOUTHWESTERN UNITED STATES, W70-02555	04D
RANGES ALKALI SACATON SEEDLINGS GERMINATION AND SURVIVAL IN AN AGAR AND SOIL MEDIUM, W70-02685	04A	RESERVOIR CONSTRUCTION CONSTRUCTION OF THE KRASNAYARSK RESERVOIR AND ITS SHORE DEVELOPMENT (RUSSIAN), W70-02480	08A
RASCHIG RINGS NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- II. NITRIFICATION IN TRICKLING FILTERS, W70-02604	05D	VIGILANCE OVER RESERVOIRS, W70-02639	06E
RAW SLUDGE THE PROTEOLYTIC BACTERIA PRESENT IN THE ANAEROBIC DIGESTION OF RAW SEWAGE SLUDGE, W70-02602	05D	RESERVOIR OPERATION EFFECT OF INTAKE ELEVATION AND OPERATION ON WATER TEMPERATURE, W70-02456	08B
REGENERATION		CONSTRUCTION OF THE KRASNAYARSK RESERVOIR AND ITS SHORE DEVELOPMENT (RUSSIAN), W70-02480	08A
		UNLAWFUL ENTRY UPON RESERVOIRS, PONDS, AND DAMS. W70-02519	06E
		VIGILANCE OVER RESERVOIRS, W70-02639	06E
		RESERVOIR SILTING HYDROGRAPHIC AND SEDIMENTATION SURVEY OF KAJAKAI RESERVOIR, AFGHANISTAN,	

SUBJECT INDEX

RES-SAL			
W70-02669	02J	W70-02579	04A
RESERVOIR STORAGE HYDROGRAPHIC AND SEDIMENTATION SURVEY OF KAJAKAI RESERVOIR, AFGHANISTAN,	02J	W70-02580	04A
W70-02669		W70-02583	04A
RESERVOIRS SUSPENDED SEDIMENTS UNDER TURBULENT CONDITIONS (RUSSIAN),	02J	BIPARIAN RIGHTS THE USE OF STREAM CHANNELS TO DELIVER STORED WATER THE POSSIBILITY OF INTERFERENCE BY THIRD PARTIES, W70-02765	05E
W70-02481			
SOME EXPERIENCE IN THE STUDY OF THE DYNAMICS OF A BENTHONIC WATER LAYER IN THE NEAR-SHORE ZONE OF RESERVOIRS (RUSSIAN),	02H	RIPRAP EROSION PREVENTION EXPERIMENTS, W70-02730	04D
W70-02483			
UNLAWFUL ENTRY UPON RESERVOIRS, PONDS, AND DAMS.	02E	RIVER FLOW ALKALINITY BUDGET OF THE COLUMBIA RIVER, W70-02642	02K
W70-02519			
PYMATUNING SWAMP DAM.	04A	RIVER REGULATION LOCATION AND IMPROVEMENT OF RIVERS AND STREAMS. W70-02537	04A
W70-02536			
DENSITY FLOW REGIME OF ROOSEVELT LAKE,	02H	POWER OF BOARD OF COMMISSIONERS OF NAVIGATION TO LICENSE PILOTS. W70-02817	06E
W70-02716			
RESIDENCE AGE EVALUATION OF FACTORS AFFECTING STREAM SELF-PURIFICATION,	05G	RIVER TRAINING LOCATION AND IMPROVEMENT OF RIVERS AND STREAMS. W70-02537	04A
W70-02758			
RESOURCE DEVELOPMENT MOUNTAIN AND DESERT LAKES IN SOUTHERN KAZAKHSTAN, THEIR RESOURCES AND METHODS OF ECONOMIC DEVELOPMENT,	02H	RIVERS SUSPENDED SEDIMENTS UNDER TURBULENT CONDITIONS (RUSSIAN), W70-02481	02J
W70-02564			
RESPIRATION RESPIRATION CORRECTIONS FOR BACTERIAL UPTAKE OF DISSOLVED ORGANIC COMPOUNDS IN NATURAL WATERS, W70-02641	05A	INDIRECT EVALUATION OF SOME CHARACTERISTICS OF A HYDROLOGICAL REGIME OF RIVERS UNDER CONDITIONS OF EXCESSIVE MOISTURE (RUSSIAN), W70-02462	02A
SOME FACTORS AFFECTING RESPIRATION OF PERIPHYTON COMMUNITIES IN LOTIC ENVIRONMENTS,	05C	RIVER ICE JAMS - A LITERATURE REVIEW, W70-02494	02C
W70-02781			
RETAINING WALLS REVERTENTS FOR BANK PROTECTION USING VERY ROUGH-SURFACED FERRO-CONCRETE ELEMENTS (FRENCH),	08A	TAKING UP DRIFTING LUMBER. W70-02806	06E
W70-02696			
HISTORICAL, FIELD AND EXPERIMENTAL STUDIES OF THE SUEZ CANAL BANK PROTECTION,	08A	AUTHORITY TO ERECT BRIDGES. W70-02812	06E
W70-02698			
METHODS OF BANK PROTECTION FOR PORT, INLAND WATER-WAY AND RIVER, W70-02699	08A	RIVERS AND HARBORS ACT INTERSTATE COMMERCE - NAVIGABLE RIVERS - INDUSTRIAL WASTE CLOGGING CHANNEL HELD NOT UNLAWFUL OBSTRUCTION - UNITED STATES V REPUBLIC STEEL CORP (7TH CIR 1959). W70-02512	05G
REVEGETATION STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GROWTH AND FORAGE PRODUCTION OF DHAMAN (CENCHRUS CILIARIS) AND SEWAN (LASIurus SINDICUS) PASTURES IN THE ESTABLISHMENT YEAR, W70-02554	03F	ROUGHNESS COEFFICIENT FRICTION FACTORS FOR FLOW IN SAND-BED CHANNELS, W70-02461	02J
REVERSE FILTERS EROSION PREVENTION EXPERIMENTS,	04D	RUNOFF THE ROLE OF SOLID AND LIQUID PRECIPITATIONS IN RUNOFF FORMATION (RUSSIAN), W70-02654	02C
W70-02730			
REVIEWS RIVER ICE JAMS - A LITERATURE REVIEW, W70-02494	02C	FERTILIZATION OF LAKES BY AGRICULTURAL AND URBAN DRAINAGE, W70-02787	05B
A PRIMER ON WASTE WATER TREATMENT.	05D	RUNOFF SIMULATION DETERMINATION OF FLOWS FOR UNGAGED STREAMS, W70-02788	02A
W70-02638			
BEDLOAD FORMULAS,	02J	SAFETY VIGILANCE OVER RESERVOIRS, W70-02639	06E
W70-02671			
RHODE ISLAND DRAINAGE RIGHTS.	04A	MINING SAFETY ZONES. W70-02819	06E
W70-02515			
DEPARTMENT OF NATURAL RESOURCES.	06E	BRIDGES MADE SAFE. W70-02839	06E
W70-02584			
FISH AND GAME LAWS - GENERAL PROVISIONS.	06E	SAILING LANDS MAY BE GRANTED OR EXCHANGED TO PROMOTE BOATING. W70-02682	06E
W70-02589			
FRESH AND COMMON SHELLFISHERIES.	06E	SAIN-LAWRENCE RIVER SHORE EROSION AND PROTECTION ST. LAWRENCE RIVER-CANADA, W70-02697	08A
W70-02590			
FISH AND GAME OYSTER GROUND LEASES.	06E	SALINE SOILS SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL, W70-02729	02G
W70-02591			
FISHING LICENSES.	06E	SALINE WATER INTRUSION SALT-WATER ENCROACHMENT INTO AQUIFERS. W70-02484	02L
W70-02598			
CULTIVATION OF FISH.	06E	COMBATING SALT-WATER ENCROACHMENT INTO THE BISCAYNE AQUIFER OF MIAMI, FLORIDA, W70-02485	02L
W70-02599			
W70-02718	06E	SALT-WATER INTRUSION IN SOUTHEASTERN FLORIDA, W70-02486	02L
FISHING BY NON-RESIDENTS.	06E	PLANNING AND PROVIDING AN ADEQUATE SUPPLY OF WATER FOR ORANGE COUNTY, CALIFORNIA, W70-02487	02L
W70-02732			
PROTECTION OF FISHING GROUNDS.	06E	PROTECTING LONG ISLAND AQUIFERS AGAINST SALT-WATER INTRUSION, W70-02488	02L
W70-02737			
RIDDANCE(LEGAL ASPECTS) BAER V BD OF COUNTY COM'RS OF WASHINGTON COUNTY,	04C		
W70-02517			
THE LAW OF SURFACE WATER IN MISSOURI,			

SUBJECT INDEX

SAL-SEW

THE CHALLENGE OF WATER MANAGEMENT DISTRICT, CALIFORNIA, W70-02489	ORANGE COUNTY WATER 02L	TEMPERATURE FLUCTUATIONS SPECTRA IN THE SEA SURFACE LAYER (RUSSIAN), W70-02647	02L
THE HYDROGEOLOGIC SETTING IN LOS ANGELES COUNTY, CALIFORNIA, W70-02490	02L		
THE AMELIORATION OR PREVENTION OF SALT-WATER INTRUSION IN AQUIFERS - EXPERIENCE IN LOS ANGELES COUNTY, CALIFORNIA, W70-02491	02L	TOTAL SUMMER EVAPORATION IN THE CENTRAL MOUNTAIN BELT OF TRANSILIAN ALATAU AND THE EFFECT OF SLOPE EXPOSURE ON EVAPORATION (RUSSIAN), W70-02651	02D
LEGAL AND ECONOMIC ASPECTS OF SALT-WATER ENCROACHMENT INTO COASTAL AQUIFERS, W70-02492	02L	SEASONAL FREEZING AND ITS HYDROLOGICAL EFFECT UNDER THE CONDITIONS OF THE NORTHERN SLOPE OF THE TRANSILIAN ALA TAU (RUSSIAN), W70-02653	02C
SALINITY SOIL FORMATION AND SALT MIGRATION IN THE MURGAB RIVER DELTA, W70-02565	02G	SEAWATER NEW TABLES FOR OXYGEN SATURATION OF SEAWATER, W70-02704	01B
SALINITY SENSORS SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL, W70-02729	02G	THE DETERMINATION OF THE ENGINEERING THERMO-PHYSICAL PROPERTIES OF SOLUTIONS CONTAINING DISSOLVED SOLIDS, W70-02749	02K
SALMON SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS, W70-02724	04C	SECONDARY TREATMENT COMPACT ACTIVATED-SLUDGE TREATMENT OF COMBINED PETROCHEMICAL MUNICIPAL WASTE, W70-02600	05D
SALT TRANSPORT(PLANTS) EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS. VI EFFECTS OF THE EXTERNAL OSMOTIC WATER POTENTIAL ON SOLUTE REQUIREMENT, SALT TRANSPORT KINETICS AND GROWTH RATES OF LEAVES, W70-02566	02I	SEDIMENT LOAD SUSPENDED SEDIMENTS UNDER TURBULENT CONDITIONS (RUSSIAN), W70-02481	02J
SALTS EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS. VI EFFECTS OF THE EXTERNAL OSMOTIC WATER POTENTIAL ON SOLUTE REQUIREMENT, SALT TRANSPORT KINETICS AND GROWTH RATES OF LEAVES, W70-02566	02I	SEDIMENT TRANSPORT COORDINATION IN MOBILE-BED HYDRAULICS, W70-02463	08B
SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL, W70-02729	02G	MOVEMENT OF SAND IN TUNNELS, W70-02465	08B
SAMPLING ATTAINABLE ACCURACY OF LINEAR STATISTICAL FORECASTING AND OPTIMAL DIMENSIONS OF THE PREDICTOR (RUSSIAN), W70-02656	02B	SCALING PROCEDURES FOR MOBILE BED HYDRAULIC MODELS IN TERMS OF SIMILITUDE THEORY, W70-02473	02J
SANDS FACTORS DETERMINING THE HYDRAULIC CONDUCTIVITY OF RED MEDITERRANEAN SOILS AND DERIVED TYPES, W70-02558	02G	COMPARISON OF WIND WAVE AND UNIFORM WAVE EFFECTS ON A BEACH, W70-02476	02L
OOLITIC ARAGONITE AND QUARTZ SAND LABORATORY COMPARISON UNDER WAVE ACTION, W70-02624	08E	BASIN TRACER CURVES INTERPRETED BY BASIC ANALYTICS, W70-02633	07B
SANITARY ENGINEERING ENGINEERING ASPECTS OF WASTEWATER CONTRACTS, W70-02605	05D	BEDLOAD FORMULAS, W70-02671	02J
ANALOG SIMULATION OF ACTIVATED SLUDGE SYSTEMS, W70-02608	05D	SEDIMENTARY BASINS(GEOLOGICAL) GEOCHEMISTRY AND ORIGIN OF FORMATION WATERS IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. STABLE ISOTOPES OF HYDROGEN AND OXYGEN, W70-02628	02K
DESIGN PRINCIPLES OF WASTE STABILIZATION PONDS, W70-02609	05D	SEDIMENTATION RATE AND DIRECTION OF GROUNDWATER CIRCULATION IN CLOSE SPACED BEDROCK AND GRAVEL WELLS UNDER NON-SYNCHRONOUS PUMPING TIME AND RATES, W70-02735	04B
PRELIMINARY DESIGN OF WASTEWATER TREATMENT SYSTEMS, W70-02610	05D	SEDIMENTS OOLITIC ARAGONITE AND QUARTZ SAND LABORATORY COMPARISON UNDER WAVE ACTION, W70-02624	08E
ENERGY CONCEPTS OF AEROBIC MICROBIAL METABOLISM, W70-02613	05D	SEDIMENTARY PHOSPHORUS IN LAKE CORES--ANALYTICAL PROCEDURE, W70-02801	05A
SASKATCHEWAN(CANADA) A LIMNOLOGICAL COMPARISON OF TWELVE LARGE LAKES IN NORTHERN SASKATCHEWAN, W70-02511	02H	SEEDS GERMINATION STUDIES OF PERENNIAL GRASS SEEDS, W70-02552	02I
SATURATED FLOW NONLINEAR FLOW IN POROUS MEDIA, W70-02464	02F	SELF-PURIFICATION EVALUATION OF FACTORS AFFECTING STREAM SELF-PURIFICATION, W70-02758	05G
SCALE DEPOSITION ULTRASONIC DETECTION OF CALCIUM SULFATE SCALE ON METAL SURFACES, W70-02690	08G	SEMIARID CLIMATES THE MAJARDAH SCHEME, W70-02560	03F
SCALING ULTRASONIC DETECTION OF CALCIUM SULFATE SCALE ON METAL SURFACES, W70-02690	08G	MULTIPLE USE OF MEDITERRANEAN RANGE LANDS NEW APPROACHES TO OLD PROBLEMS, W70-02567	03F
EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION, W70-02692	08G	SENESCENCE EUTROPHICATION AND SENESCENCE IN A GROUP OF PRAIRIE-PARKLAND LAKES IN ALBERTA, CANADA, W70-02802	05C
SCOUR LOCAL SCOUR AROUND BRIDGE PIERS, W70-02462	08B	SEPARATION TECHNIQUES INTERACTION OF INORGANIC AND ORGANIC FERTILIZER MATERIALS WITH PESTICIDES AS RELATED TO WATER QUALITY IN SOILS, W70-02761	05B
SEA ICE STALACTITE GROWTH BENEATH SEA ICE, W70-02620	02C	SET-NETS MISCELLANEOUS PROVISIONS (RELATING TO WATER), W70-02544	05G
SEA WATER PARTICULATE ALUMINUM AND IRON IN SEA WATER OFF THE SOUTHEASTERN COAST OF THE UNITED STATES, W70-02630	02K	SEWAGE DISCHARGE OF SEWAGE ON OR WITHIN LIMITS OF HIGHWAY, W70-02545	06E
		SEWAGE DISPOSAL FERTILIZATION OF LAKES BY AGRICULTURAL AND URBAN DRAINAGE, W70-02787	05B
		SEWAGE POLLUTION.	

SUBJECT INDEX

SEW-SOI		
W70-02833	05G	
SEWAGE EFFLUENTS DISCHARGE OF SEWAGE EFFLUENT FROM A LINE SOURCE INTO A STRATIFIED OCEAN. W70-02714	05D	SLUDGE DISPOSAL SLUDGE DISPOSAL EXPERIENCES AT NORTH LITTLE ROCK, ARKANSAS, W70-02616 05D
SEWAGE TREATMENT PREVENTION OF POLLUTION. W70-02514	05G	SLUDGE TREATMENT ANALOG SIMULATION OF ACTIVATED SLUDGE SYSTEMS, W70-02608 05D
DESIGN PRINCIPLES OF WASTE STABILIZATION PONDS, W70-02609	05D	SMALL WATERSHEDS GENERALIZED ANALYSIS OF SMALL WATERSHED RESPONSES, W70-02763 02A
A PRIMER ON WASTE WATER TREATMENT. W70-02638	05D	SNOW A METHOD FOR THE DETERMINATION OF SNOW RESOURCES IN A MOUNTAIN BASIN (RUSSIAN), W70-02649 02C
SEWER SYSTEMS SEWAGE POLLUTION. W70-02833	05G	THE ROLE OF SOLID AND LIQUID PRECIPITATIONS IN RUMCFF FORMATION (RUSSIAN), W70-02654 02C
SHARK RIVER SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK, W70-02631	04C	SNOWBELT A METHOD FOR THE DETERMINATION OF SNOW RESOURCES IN A MOUNTAIN BASIN (RUSSIAN), W70-02649 02C
SHEAR MODULUS DYNAMIC BEHAVIOR OF SOIL, W70-02751	08E	SOIL CHEMICAL PROPERTIES THE EFFECT OF GIPSUM ON THE WATER STORAGE IN A SANDY LOAM SOIL UNDER AN IRRIGATED PERENNIAL PASTURE, W70-02557 02G
SHELLFISH TOWN CONTROL OF FISHERIES. W70-02592	06E	SOIL COMPACTION EFFECTS OF UNIT WEIGHT AND SLOPE ON EROSION, W70-02451 02J
SIMULTANEOUS DETERMINATION OF ZN-65-30 AND P-32-15 IN SHELLFISH BY RADIOCHEMICAL TECHNIQUES, W70-02796	05A	SOIL CONSERVATION SOIL CONSERVATION POLICY. W70-02521 04D
SHOCK LOADS STABILIZATION OF AN ACTIVATED SLUDGE PLANT, W70-02593	05D	THE MAJARDAH SCHEME, W70-02560 03F
SHORES SOME EXPERIENCE IN THE STUDY OF THE DYNAMICS OF A BENTHONIC WATER LAYER IN THE NEAR-SHORE ZONE OF RESERVOIRS (RUSSIAN), W70-02483	02H	SOIL EROSION EFFECTS OF UNIT WEIGHT AND SLOPE ON EROSION, W70-02451 02J
SILT DYNAMIC BEHAVIOR OF SOIL, W70-02751	08E	SOIL CONSERVATION POLICY. W70-02521 04D
SIMULATION DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE SIMULATION OF FLATLAND WATERSHED HYDRAULICS, W70-02676	02G	SOIL FORMATION FACTORS DETERMINING THE HYDRAULIC CONDUCTIVITY OF BED MEDITERRANEAN SOILS AND DERIVED TYPES, W70-02558 02G
SIMULATION ANALYSIS OPEN-CHANNEL SURGE SIMULATION BY DIGITAL COMPUTER, W70-02459	08B	SOIL FORMATION AND SALT MIGRATION IN THE MURGAB RIVER DELTA, W70-02565 02G
SINKING BUOYANCY AND SINKING CHARACTERISTICS OF FRESHWATER PHYTOPLANKTON, W70-02754	05G	SOIL FREEZING INVESTIGATION OF SOIL FREEZING, W70-02750 08E
SIZE FRESHWATER PRIMARY PRODUCTION BY A BLUE-GREEN ALGA OF BACTERIAL SIZE, W70-02508	02B	SOIL FUNGI WATER REPELLENT SOILS A WORLDWIDE CONCERN IN MANAGEMENT OF SOIL AND VEGETATION, W70-02686 08A
PHOSPHORUS EXCRETION AND BODY SIZE IN MARINE ANIMALS MICROZOOPHYTON AND NUTRIENT REGENERATION, W70-02791	05C	SOIL MOISTURE THE EFFECT OF GYPSUM ON THE WATER STORAGE IN A SANDY LOAM SOIL UNDER AN IRRIGATED PERENNIAL PASTURE, W70-02557 02G
SKAWA RIVER(POLAND) CLADOPHORA GLOMERATA AND CONCOMITANT ALGAE IN THE RIVER SKAWA. DISTRIBUTION AND CONDITIONS OF APPEARANCE, W70-02784	05C	SOIL MOISTURE STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GROWTH AND FORAGE PRODUCTION OF DHANAN (CENOCERUS CILIARIS) AND SENAN (LASIOSIRUS SINDICUS) PASTURES IN THE ESTABLISHMENT YEAR, W70-02554 03F
SLABS REVESTMENTS FOR BANK PROTECTION USING VERY ROUGH-SURFACED FERRO-CONCRETE ELEMENTS (FRENCH), W70-02696	08A	SOIL PHYSICAL PROPERTIES FILTRATION PROPERTIES OF THE SOIL OF THE MOUNTAINS ON THE NORTHERN SLOPE OF TRANSILIAN ALA TAU (RUSSIAN), W70-02652 02G
SLOPE STABILITY CALCULATION OF SLOPE STABILITY OF RIVERS AND DRAINAGE CANALS (RUSSIAN), W70-02658	02E	SOIL STRUCTURE FACTORS DETERMINING THE HYDRAULIC CONDUCTIVITY OF BED MEDITERRANEAN SOILS AND DERIVED TYPES, W70-02558 02G
SLOPES EFFECTS OF UNIT WEIGHT AND SLOPE ON EROSION, W70-02451	02J	SOIL WATER MOVEMENT INFILTRATION OF WATER INTO HOMOGENEOUS SOIL, W70-02487 02G
TOTAL SUMMER EVAPORATION IN THE CENTRAL MOUNTAIN BELT OF TRANSILIAN ALATAU AND THE EFFECT OF SLOPE EXPOSURE ON EVAPORATION (RUSSIAN), W70-02651	02D	ANALYSIS OF INFILTRATION INTO DRAINING POROUS MEDIA, W70-02448 02G
FILTRATION PROPERTIES OF THE SOIL OF THE MOUNTAINS ON THE NORTHERN SLOPE OF TRANSILIAN ALA TAU (RUSSIAN), W70-02652	02G	FILTRATION PROPERTIES OF THE SOIL OF THE MOUNTAINS ON THE NORTHERN SLOPE OF TRANSILIAN ALA TAU (RUSSIAN), W70-02652 02G
CALCULATION OF SLOPE STABILITY OF RIVERS AND DRAINAGE CANALS (RUSSIAN), W70-02658	02E	SEASONAL FREEZING AND ITS HYDROLOGICAL EFFECT UNDER THE CONDITIONS OF THE NORTHERN SLOPE OF THE TRANSILIAN ALA TAU (RUSSIAN), W70-02653 02C
SLUDGE DIGESTION THE METHANE FERMENTATION BETWEEN MESOPHILIC AND THERMOPHILIC TEMPERATURE RANGES, W70-02597	05D	WATER REPELLENT SOILS A WORLDWIDE CONCERN IN MANAGEMENT OF SOIL AND VEGETATION,

W70-02686	04A	STREAM MODELS EVALUATION OF FACTORS AFFECTING STREAM SELF-PURIFICATION, W70-02758	05G
SOIL-WATER-PLANT RELATIONSHIPS EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS. VI. EFFECTS OF THE EXTERNAL OSMOTIC WATER POTENTIAL ON SOLUTE REQUIREMENT, SALT TRANSPORT KINETICS AND GROWTH RATES OF LEAVES. W70-02566	02I	STREAMFLOW FLOODS IN MISSISSIPPI-SEPTEMBER 1965 THROUGH SEPTEMBER 1967, W70-02621	02E
DETERMINATIONS OF LEAF AND FRUIT WATER POTENTIAL WITH A PRESSURE CHAMBER. W70-02568	02I	SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK, W70-02631	04C
SOLUBILITY SOLUBILITIES OF NITROGEN, OXYGEN, AND ARGON IN DISTILLED WATER, W70-02701	02K	IMPOUNDMENT INFLUENCES ON WATER QUALITY, W70-02785	05G
SOLUBILITY OF ATMOSPHERIC OXYGEN IN WATER, W70-02702	02K	STREAMS STRUCTURAL CHARACTERISTICS OF BENTHIC ALgal COMMUNITIES IN LABORATORY STREAMS, W70-02780	05C
NEW TABLES FOR OXYGEN SATURATION OF SEAWATER, W70-02704	01B	SOME EFFECTS OF CURRENT VELOCITY ON PERiphyton COMMUNITIES IN LABORATORY STREAMS, W70-02794	05C
DETERMINATION OF DISSOLVED OXYGEN BY THE WINKLER METHOD AND THE SOLUBILITY OF OXYGEN IN PURE WATER AND SEA WATER. W70-02705	02K	CLEAN STREAMS LAW. W70-02832	05G
NEW MEASUREMENTS OF OXYGEN SOLUBILITY IN PURE AND NATURAL WATER, W70-02712	02K	JURISDICTION OF COUNTIES ON BOUNDARY WATERS. W70-02841	06E
SORPTION STUDY OF A DESIGN-OPTIMIZATION PROCEDURE FOR ION-EXCHANGE AND ADSORPTION COLUMNS, W70-02687	03A	STRESS-STRAIN DYNAMIC BEHAVIOR OF SOIL, W70-02751	08E
SORPTION PROCESSES STUDY OF A DESIGN-OPTIMIZATION PROCEDURE FOR ION-EXCHANGE AND ADSORPTION COLUMNS, W70-02687	03A	STRUCTURAL GEOLOGY RELATION OF BEDROCK FRACTURE SYSTEMS TO UNDERGROUND WATER SUPPLIES IN THE STAFFORD SPRINGS, SOUTH CONVENTRY, SPRING HILL, AND WESTFORD QUADRANGLES, W70-02756	02F
SOUTHWEST U RANGE SEEDING PROBLEMS AND RESEARCH IN THE PINYON-JUNIPER WOODLAND TYPE OF SOUTHWESTERN UNITED STATES, W70-02555	04D	STURGEON CONSERVATION AND CONTROL OF AQUATIC PLANTS AND FISH. W70-02838	04A
SPAWNING STREAMS SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS, W70-02724	04C	STURGEONS WILDLIFE CONSERVATION. W70-02835	06E
SPECIFIC HEAT THE DETERMINATION OF THE ENGINEERING THERMO-PHYSICAL PROPERTIES OF SOLUTIONS CONTAINING DISSOLVED SOLIDS, W70-02749	02K	SUBMERGED FLOW FLOW BELOW DEEPLY SUBMERGED RECTANGULAR WEIRS, W70-02472	02E
SPECIFIC SURFACE NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- II. NITRIFICATION IN TRICKLING FILTERS, W70-02604	05D	SUBMERGED WEIRS FLOW BELOW DEEPLY SUBMERGED RECTANGULAR WEIRS, W70-02472	02E
SPILLWAYS A STUDY OF FLOW CONDITIONS IN SHAFT SPILLWAYS, W70-02774	08A	SUBSURFACE DRAINAGE DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE SIMULATION OF FLATLAND WATERSHED HYDRAULICS, W70-02676	02G
SPRINGS MEASURING SUBSURFACE SPRING FLOW WITH RADIOTRACERS, W70-02637	07B	SUCCESSION THE SUCCESSION OF 'BLOOM' SPECIES OF BLUE-GREEN ALGAE AND SOME CAUSAL FACTORS, W70-02684	02H
BRINE SPRINGS IN THE ZWICKAU-OELSNITZ COAL AREA (GERMAN), W70-02673	05B	SULPHYDRYL REACTIVITY CORRELATION OF STRUCTURE VS ACTIVITY OF POLLUTANTS OF FRESH WATER, W70-02753	05C
SPRINKLER IRRIGATION SPRINKLER IRRIGATION SPRAY TEMPERATURES, W70-02563	03F	SULPHYDRYL-THIOL AFFINITY-RATE ASSAY CORRELATION OF STRUCTURE VS ACTIVITY OF POLLUTANTS OF FRESH WATER, W70-02753	05C
STAGE-DISCHARGE RELATIONS TRIANGULAR BROAD-CRESTED WEIR, W70-02449	07B	SULFUR BACTERIA ECOLOGY OF SELECTED AQUATIC BACTERIA IN THE SNAKE RIVER, W70-02762	05C
STARVATION INFLUENCE OF STARVATION ON SELECTED TEMPERATURE OF SOME SALMONIDS, W70-02706	05C	SUPERVISORY CONTROL(POWERS) SCRUYLKILL RIVER POLLUTION. W70-02828	05G
STATE GOVERNMENTS APPROPRIATION AND CONDEMNATION OF LANDS AND WATERS TO ENABLE COMPLETION OF AUTHORIZED PROJECTS. W70-02529	06E	SUPERVISORY CONTROL(POWER) OBSTRUCTIONS NOT TO BE MADE OR ALTERED WITHOUT CONSENT. W70-02534	04A
DEPARTMENT OF NATURAL RESOURCES. W70-02584	06E	SURFACE AERATORS EXPERIMENTAL PROBLEMS ASSOCIATED WITH THE TESTING OF SURFACE AERATION EQUIPMENT, W70-02612	05D
STATISTICAL METHODS ATTAINABLE ACCURACY OF LINEAR STATISTICAL FORECASTING AND OPTIMAL DIMENSIONS OF THE PREDICTOR (RUSSIAN), W70-02656	02B	SURFACE DRAINAGE PETITION TO COURT FOR DRAINAGE AND APPOINTMENT OF COMMISSIONERS. W70-02520	04A
STILLING BASINS FLUCTUATING PRESSURES IN SPILLWAY STILLING BASINS, W70-02457	08B	SURFACE RUNOFF THE LAW OF SURFACE WATER IN MISSOURI, W70-02578	04A
STILLING-BASIN PRESSURE FLUCTUATIONS FLUCTUATING PRESSURES IN SPILLWAY STILLING BASINS, W70-02457	08B	THE ROLE OF SOLID AND LIQUID PRECIPITATIONS IN EROSION FORMATION (RUSSIAN), W70-02654	02C
STORM RUNOFF URBAN RUNOFF BY ROAD RESEARCH LABORATORY METHOD, W70-02467	04C	GENERALIZED ANALYSIS OF SMALL WATERSHED RESPONSES, W70-02763	02A
SURFACE WATERS INDIRECT EVALUATION OF SOME CHARACTERISTICS OF A			

HYDROLOGICAL REGIME OF RIVERS UNDER CONDITIONS OF EXCESSIVE MOISTURE (RUSSIAN), W70-02482	02A	W70-02637	07B
THE LAW OF SURFACE WATER IN MISSOURI, W70-02577	08A	THEORETICAL ANALYSIS GROUND WATER SEEPAGE PATTERNS TO WELLS FOR UNCONFINED FLOW, W70-02759	02E
W70-02578	08A	THE THERMAL EFFLUENT MIXING THERMAL DISCHARGES FROM LARGE NUCLEAR PLANT, W70-02635	05B
W70-02581	04A	THERMAL POLLUTION THERMAL DISCHARGES FROM LARGE NUCLEAR PLANT, W70-02635	05B
WATFR IN THE KAHUKU AREA, OAHU, HAWAII, W70-02623	03B	USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES, W70-02709	05B
BIG BLACK RIVER, MISSISSIPPI COMPREHENSIVE BASIN STUDY - ANNEX F, GEOLOGY AND WATER RESOURCES, W70-02672	02E	COOLING WATER STUDIES AT ELECTRIC POWER STATION, W70-02713	05B
SURFACE-GROUNDWATER RELATIONSHIPS THEORETICAL BASEFLOW CURVES, W70-02460	02A	A HYDRAULIC MODEL STUDY OF HEAT DISSIPATION AT KINCARDINE POWER STATION, W70-02717	05B
SURGES OPEN-CHANNEL SURGE SIMULATION BY DIGITAL COMPUTER, W70-02459	08B	THERMAL POWER PLANTS COOLING WATER STUDIES AT ELECTRIC POWER STATION, W70-02713	05B
SURVEYS RIVER ICE JAMS - A LITERATURE REVIEW, W70-02494	02C	A HYDRAULIC MODEL STUDY OF HEAT DISSIPATION AT KINCARDINE POWER STATION, W70-02717	05B
SUSPENDED LOAD SUSPENDED SEDIMENTS UNDER TURBULENT CONDITIONS (RUSSIAN), W70-02481	02J	Thermal Stratification Density Flow Regime of Roosevelt Lake, W70-02716	02H
SWAMP MEASUREMENT OF EVAPOTRANSPIRATION IN LOWLAND VEGETATION, W70-02733	02D	THERMODYNAMIC BEHAVIOR THERMODYNAMIC MIXING PROPERTIES OF NaCl LIQUIDS, W70-02627	02K
SWAMPS PUBLIC LANDS AND SWAMPS - SALES - PUBLIC USE. W70-02588	04A	THIOL AFFINITY-SULPHYDRYL-REACTIVE AGENTS CORRELATION OF STRUCTURE VS ACTIVITY OF POLLUTANTS OF FRESH WATER, W70-02753	05C
SYSTEMS ANALYSIS AN EXAMINATION OF NONTREATMENT PLANT ALTERNATIVES IN WATER POLLUTION CONTROL W70-02695	05G	TIDAL EFFECTS Hurricane Camille Tidal Floods of August 1969 Along the Gulf Coast, Kreole-Grand Bay SW Quadrangles, Mississippi-Alabama, W70-02660	07C
SYSTEMS ENGINEERING STOCHASTIC BASIS FOR COMPREHENSIVE RIVER BASIN PLANNING PHASE I, W70-02681	06A	Hurricane Camille Tidal Floods of August 1969 Along the Gulf Coast, Bay St. Louis Quadrangle, Mississippi, W70-02661	07C
PLANNING FOR POWER - A LOOK AT TOMORROWS STATION SIZES, W70-02740	08C	Hurricane Camille Tidal Floods of August 1969 Along the Gulf Coast, Gulfport NW Quadrangle, Mississippi, W70-02662	07C
TAXES FLOOD CONTROL. W70-02576	04A	Hurricane Camille Tidal Floods of August 1969 Along the Gulf Coast, Vidalia Quadrangle, Mississippi, W70-02665	07C
TECHNICAL FEASIBILITY MEMBRANE FILTER-FLUORESCENT-ANTIBODY METHOD FOR DETECTION AND ENUMERATION OF BACTERIA IN WATER, W70-02782	05A	Hurricane Camille Tidal Floods of August 1969 Along the Gulf Coast, Waveland-Grand Island Pass Quadrangles, Mississippi, W70-02666	07C
TECHNIQUE MEMBRANE FILTER-FLUORESCENT-ANTIBODY METHOD FOR DETECTION AND ENUMERATION OF BACTERIA IN WATER, W70-02782	05A	TIDAL PRISM CURRENT STUDY IN THE NEUSE RIVER AND ESTUARY OF NORTH CAROLINA, W70-02760	02L
TECHNIQUES ENUMERATION OF AUTOTROPHIC AMMONIUM-OXIDIZING BACTERIA IN MARINE WATERS BY A DIRECT METHOD, W70-02507	07B	TIDAL WATERS PROTECTION OF FISHING GROUNDS. W70-02737	06E
TEMPERATURE ALKALI SACATON SEEDLINGS GERMINATION AND SURVIVAL IN AN AGAR AND SOIL MEDIUM, W70-02685	08A	TIMING EXPRESSING IRRIGATION EFFICIENCY IN TERMS OF APPLICATION TIME, INTAKE AND WATER ADVANCE CONSTANTS, W70-02556	03F
NEW TABLES FOR OXYGEN SATURATION OF SEAWATER, W70-02704	01B	TITANIUM EVALUATION OF TITANIUM-PLATED STEEL IN A CHLORIDE ENVIRONMENT, W70-02741	08G
CONSIDERATIONS ON HYDRAULIC MODELS TO BE EMPLOYED TO STUDY RECIRCULATION INTAKE CONDITIONS OF COOLING WATER IN STEAM POWER STATIONS, W70-02707	05B	TITANIUM PLATING EVALUATION OF TITANIUM-PLATED STEEL IN A CHLORIDE ENVIRONMENT, W70-02741	08G
THE EFFECT OF Elevated TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE, W70-02710	05D	TOTAL COUNTS THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTES, W70-02614	05D
NEW MEASUREMENTS OF OXYGEN SOLUBILITY IN PURE AND NATURAL WATER, W70-02712	02K	TOXIC SUBSTANCES THE EFFECT OF METHANE ANALOGUES ON METHANOGENESIS IN ANAEROBIC DIGESTION, W70-02595	05D
TEMPERATURE CONTROL SPRINKLER IRRIGATION SPRAY TEMPERATURES, W70-02563	03P	TOXICITY EFFECT OF BORON ON BIOLOGICAL WASTE TREATMENT, W70-02734	05D
TEMPERATURE SELECTION INFLUENCE OF STARVATION ON SELECTED TEMPERATURE OF SOME SALMONIDS, W70-02706	05C	TRACE ELEMENTS LEAD AND OTHER METAL IONS IN UNITED STATES PRECIPITATION, W70-02444	05B
TERtiARY TREATMENT INFLUENCE OF pH ON THE ADSORPTION OF AROMATIC ACIDS ON ACTIVATED CARBON, W70-02443	05G	TRACE METALS ANALYSIS OF TRACE ELEMENTS IN WATER, W70-02768	05A
TEXAS MEASURING SUBSURFACE SPRING FLOW WITH RADIOTRACERS,			

TRACERS DESIGN PRINCIPLES OF WASTE STABILIZATION PONDS, W70-02609	05D	UNSTEADY FLOW FLUCTUATING PRESSURES IN SPILLWAY STILLING BASINS, W70-02457	08B
BASIN TRACER CURVES INTERPRETED BY BASIC ANALYTICS, W70-02633	07B	UPTAKE INTERPRETATION OF RADIONUCLIDE UPTAKE FROM AQUATIC ENVIRONMENTS, W70-02786	05A
MEASURING SUBSURFACE SPRING FLOW WITH RADIOTRACERS, W70-02637	07B	URBAN DRAINAGE FERTILIZATION OF LAKES BY AGRICULTURAL AND URBAN DRAINAGE, W70-02787	05B
EVALUATION OF FACTORS AFFECTING STREAM SELF-PURIFICATION, W70-02758	05G	URBANIZATION URBAN RUNOFF BY ROAD RESEARCH LABORATORY METHOD, W70-02467	04C
TRACKING TECHNIQUES BASIN TRACER CURVES INTERPRETED BY BASIC ANALYTICS, W70-02633	07B	FLOODS OF JUNE 1, 1967 IN SOUTHWESTERN JACKSON, MISSISSIPPI, W70-02477	02E
TRAFFIC CAPACITY HISTORICAL, FIELD AND EXPERIMENTAL STUDIES OF THE SUEZ CANAL BANK PROTECTION, W70-02698	08A	USE RATES A COMPREHENSIVE STUDY OF THE USE TAX AS A MEANS OF ALLOCATION OF WATER RESOURCES IN A CONJUNCTIVE USE SYSTEM, W70-02757	06C
TRAMMEL NET CONSERVATION AND CONTROL OF AQUATIC PLANTS AND FISH. W70-02838	04A	USSR CONSTRUCTION OF THE KRASNOYARSK RESERVOIR AND ITS SHORE DEVELOPMENT (RUSSIAN), W70-02480	08A
TRANSPORTATION RIVERS LAKES NAVIGABLE WATERS STATE JURISDICTION. W70-02840	06E	SUSPENDED SEDIMENTS UNDER TURBULENT CONDITIONS (RUSSIAN), W70-02481	02J
TRAWLING FISHING BY NON-RESIDENTS. W70-02732	06E	INDIRECT EVALUATION OF SOME CHARACTERISTICS OF A HYDROLOGICAL REGIME OF RIVERS UNDER CONDITIONS OF EXCESSIVE MOISTURE (RUSSIAN), W70-02482	02A
TRESPASS POLLUTION TRESPASS ON STATE HATCHERIES. W70-02543	05G	SOME EXPERIENCE IN THE STUDY OF THE DYNAMICS OF A BENTHONIC WATER LAYER IN THE NEAR-SHORE ZONE OF RESERVOIRS (RUSSIAN), W70-02483	02H
TRICKLING FILTER NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- II. NITRIFICATION IN TRICKLING FILTERS, W70-02608	05D	MOUNTAIN AND DESERT LAKES IN SOUTHERN KAZAKHSTAN, THEIR RESOURCES AND METHODS OF ECONOMIC DEVELOPMENT, W70-02564	02H
TREATMENT OF KRAFT MILL WASTES WITH A PLASTIC MEDIA TRICKLING FILTER, W70-02606	05D	SOIL FORMATION AND SALT MIGRATION IN THE MURGAB RIVER DELTA, W70-02565	02G
TRICKLING FILTER COVERS DOMES PROTECT TRICKLING FILTERS, W70-02615	05D	SOME EXPERIENCE IN THE DEVELOPMENT OF LAND IN THE NEW IRRIGATION ZONE IN THE GOLODNAYA STEPPE (RUSSIAN), W70-02648	03F
TRICKLING FILTERS DOMES PROTECT TRICKLING FILTERS, W70-02615	05D	A METHOD FOR THE DETERMINATION OF SNOW RESOURCES IN A MOUNTAIN BASIN (RUSSIAN), W70-02649	02C
TRITIUM MEASURING SUBSURFACE SPRING FLOW WITH RADIOTRACERS, W70-02637	07B	SOME EXPERIENCE IN EVALUATION OF ATMOSPHERIC PRECIPITATIONS IN THE MOUNTAINS OF TRANSILIAN ALA TAU (RUSSIAN), W70-02650	02B
TROPHIC LEVELS PHYTOPLANKTON FLORA OF NEWFOUND AND WINNISQUAM LAKES, NEW HAMPSHIRE, W70-02764	05C	TOTAL SUMMER EVAPORATION IN THE CENTRAL MOUNTAIN FETT OF TRANSILIAN ALATAU AND THE EFFECT OF SLOPE EXPOSURE ON EVAPORATION (RUSSIAN), W70-02651	02D
PHYTOPLANKTON POPULATIONS IN RELATION TO TROPHIC LEVELS OF LAKES IN NEW HAMPSHIRE, U.S.A. W70-02772	05C	FILTRATION PROPERTIES OF THE SOIL OF THE MOUNTAINS ON THE NORTHERN SLOPE OF TRANSILIAN ALA TAU (RUSSIAN), W70-02652	02G
TUNISIA THE MAJARDAH SCHEME, W70-02560	03F	SEASONAL FREEZING AND ITS HYDROLOGICAL EFFECT UNDER THE CONDITIONS OF THE NORTHERN SLOPE OF THE TRANSILIAN ALA TAU (RUSSIAN), W70-02653	02C
TUNNEL CONSTRUCTION DELAWARE RIVER TUNNEL AND BRIDGE. W70-02814	06E	THE ROLE OF SOLID AND LIQUID PRECIPITATIONS IN RUNOFF FORMATION (RUSSIAN), W70-02654	02C
BIGET TO RUN TUNNEL UNDER RIVER TO COAL MINE. W70-02818	06E	RESULTS OF ATMOSPHERIC CIRCULATION STUDIES OVER EURASIA, ASIA, AND THE ARCTIC BY RADAR-METEOR TECHNIQUE (RUSSIAN), W70-02655	02B
TURBINE-GENERATORS PLANNING FOR POWER - A LOOK AT TOMORROWS STATION SIZES, W70-02740	08C	FREE WATER FLOW TO ROWS OF WELLS (RUSSIAN), W70-02657	02F
ULTRASONIC DETECTION ULTRASONIC DETECTION OF CALCIUM SULFATE SCALE ON METAL SURFACES, W70-02690	08G	CALCULATION OF SLOPE STABILITY OF RIVERS AND DRAINAGE CANALS (RUSSIAN), W70-02658	02E
ULTRASONICS ULTRASONIC DETECTION OF CALCIUM SULFATE SCALE ON METAL SURFACES, W70-02690	08C	VARIABLE DIVERSION DESIGN OF A COMBINED SEWER FLUIDIC REGULATOR, THE DEVELOPMENT OF BASIC CONFIGURATIONS AND DESIGN CRITERIA FOR APPLICATIONS OF FLUIDS IN SEWER REGULATORS. W70-02773	04A
UNGAGED STREAMS DETERMINATION OF FLOWS FOR UNGAGED STREAMS, W70-02748	02A	VEGETATION PHYTOSOCIOLOGICAL VARIATIONS IN FLORISTIC COMPOSITION OF THE VEGETATION IN THE ARID ZONE I. MONSOONAL VEGETATION OF THE ALLUVIAL PLAINS, W70-02553	02I
UNIT HYDROGRAPH DETERMINATION OF FLOWS FOR UNGAGED STREAMS, W70-02788	02A	VELOCITY SOME EFFECTS OF CURRENT VELOCITY ON PERiphyton COMMUNITIES IN LABORATORY STREAMS, W70-02794	05C
UNIT HYDROGRAPHS DATA ERROR EFFECTS IN UNIT HYDROGRAPH DERIVATION, W70-02454	07A	VERTICAL CONDUITS A STUDY OF FLOW CONDITIONS IN SHAFT SPILLWAYS, W70-02774	08A
UNIT STATES PARTICULATE ALUMINUM AND IRON IN SEA WATER OFF THE SOUTHEASTERN COAST OF THE UNITED STATES, W70-02630	02K		

VERTICAL SHAFT SPILLWAYS A STUDY OF FLOW CONDITIONS IN SHAFT SPILLWAYS, W70-02774	08A	PROTECTING LONG ISLAND AQUIFERS AGAINST SALT-WATER INTRUSION, W70-02488	02L
WASHINGTON GLACIAL DRAINAGE DIVIDE IN THE SKAGIT VALLEY, WASHINGTON, W70-02458	02C	THE CHALLENGE OF WATER MANAGEMENT ORANGE COUNTY WATER DISTRICT, CALIFORNIA, W70-02489	02L
WASTE DISPOSAL OHIO RIVER VALLEY SANITATION COMPACT. W70-02571	05G	THE AMELIORATION OR PREVENTION OF SALT-WATER INTRUSION IN AQUIFERS - EXPERIENCE IN LOS ANGELES COUNTY, CALIFORNIA, W70-02491	02L
WASTE TREATMENT PRELIMINARY DESIGN OF WASTEWATER TREATMENT SYSTEMS, W70-02610	05D	LEGAL AND ECONOMIC ASPECTS OF SALT-WATER ENCROACHMENT INTO COASTAL AQUIFERS, W70-02492	02L
WASTE WATER DISPOSAL DEEP WELL DISPOSAL OF WASTEWATERS IN SALINE AQUIFERS OF SOUTH FLORIDA, W70-02468	05E	WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN PENNSYLVANIA. W70-02644	04A
WASTE WATER TREATMENT A PRIMER ON WASTE WATER TREATMENT. W70-02638	05D	WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN NEW YORK. W70-02645	04A
WATER DESERTS THE PROBLEM OF WATER IN ARID LANDS, W70-02561	02A	WATER MEASUREMENT TRIANGULAR BROAD-CRESTED WEIR, W70-02449	07B
WATER ADVANCE EQUATION EXPRESSING IRRIGATION EFFICIENCY IN TERMS OF APPLICATION TIME, INTAKE AND WATER ADVANCE CONSTANTS, W70-02556	03F	WATER POLICY DELAWARE RIVER BASIN COMMISSION ANNUAL REPORT 1969. W70-02694	05G
WATER ALLOCATION OPERATIONS RESEARCH STUDY OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT OF THE TUCSON BASIN, W70-02680	06A	WATER POLLUTION POLLUTION OF DRINKING WATER. W70-02522	05F
ALLOCATIVE IMPACTS OF FEDERAL AND STATE WATER DEVELOPMENT LAW, W70-02736	06E	OHIO RIVER VALLEY WATER SANITATION COMPACT. W70-02539	05G
WATER ANALYSIS PROTON MAGNETIC RESONANCE SPECTRUM OF POLYWATER, W70-02617	01A	MISCELLANEOUS PROVISIONS (RELATING TO WATER). W70-02544	05G
WATER CHEMISTRY EFFECT OF YELLOW ORGANIC ACIDS ON IRON AND OTHER METALS IN WATER, W70-02505	02K	PETTY POLLUTION. W70-02549	05G
LIMITATION OF ALGAL GROWTH IN SOME CENTRAL AFRICAN WATERS, W70-02646	05C	DESIGN PRINCIPLES OF WASTE STABILIZATION PONDS, W70-02609	05D
WATER CONSERVATION WATER CONSERVATION AND RECLAMATION FUND. W70-02518	05G	PRELIMINARY DESIGN OF WASTEWATER TREATMENT SYSTEMS, W70-02610	05D
UNDERGROUND WATER DEVELOPMENT. W70-02530	06E	MINES AND MINING. W70-02820	05G
MUNICIPAL ASSISTANCE. W70-02808	06E	CLEAN STREAMS LAW. W70-02832	05G
DAMS AND STORAGE RESERVOIR. W70-02829	04A	WATER POLLUTION CONTROL PREVENTION OF POLLUTION. W70-02514	05G
WATER COSTS VALUE OF DESALTED WATER FOR IRRIGATION, W70-02632	03C	POTOMAC RIVER POLLUTION. W70-02535	05G
WATER HOLES FREE WATER FLOW TO ROWS OF WELLS (RUSSIAN), W70-02657	02F	POLLUTION TRESPASS ON STATE HATCHERIES. W70-02543	05G
WATER LAW THE LAW OF SURFACE WATER IN MISSOURI, W70-02577	04A	INDUSTRIAL WASTES. W70-02548	06E
THE USE OF STREAM CHANNELS TO DELIVER STORED WATER THE POSSIBILITY OF INTERFERENCE BY THIRD PARTIES, W70-02765	06E	PETTY POLLUTION. W70-02549	05G
WATER LEVEL FLUCTUATIONS ALFALFA WATER TABLE INVESTIGATIONS, W70-02650	02I	OHIO RIVER VALLEY SANITATION COMPACT. W70-02571	05G
WATER LEVELS SOME EXPERIENCE IN THE STUDY OF THE DYNAMICS OF A BENTHIC WATER LAYER IN THE NEAR-SHORE ZONE OF RESERVOIRS (RUSSIAN), W70-02483	02H	THERMAL DISCHARGES FROM LARGE NUCLEAR PLANT, W70-02635	05B
SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK, W70-02631	04C	A PRIMER ON WASTE WATER TREATMENT. W70-02638	05D
POWERS OF THE DEPARTMENT OF RESOURCE DEVELOPMENT. W70-02842	04A	DELAWARE RIVER BASIN COMMISSION ANNUAL REPORT 1969. W70-02694	05G
WATER MANAGEMENT(APPLIED) COMBATING SALT-WATER ENCROACHMENT INTO THE BISCAYNE AQUIFER OF MIAMI, FLORIDA, W70-02485	02L	AN EXAMINATION OF NONTREATMENT PLANT ALTERNATIVES IN WATER POLLUTION CONTROL W70-02695	05G
SALT-WATER INTRUSION IN SOUTHEASTERN FLORIDA. W70-02486	02L	EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING, AND PREVENTING POLLUTION, B-165606, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION. W70-02743	05G
PLANNING AND PROVIDING AN ADEQUATE SUPPLY OF WATER FOR ORANGE COUNTY, CALIFORNIA, W70-02487	02L	COMBATING POLLUTION CREATED BY OIL SPILLS, VOLUME I METHODS. W70-02744	05G
		IMPOUNDRMENT INFLUENCES ON WATER QUALITY. W70-02785	05G
		SCHUYLKILL RIVER POLLUTION. W70-02828	05G
		SEWAGE POLLUTION. W70-02833	05G
		WATER POLLUTION EFFECTS FISH CONSERVATION. W70-02836	05G

SUBJECT INDEX

WAT-WAT

WATER POLLUTION IDENTIFICATION		
SIMULTANEOUS DETERMINATION OF ZN-65-30 AND P-32-15 IN SHELFISH BY RADIOCHEMICAL TECHNIQUES,		
W70-02796	05A	
SEDIMENTARY PHOSPHORUS IN LAKE CORES--ANALYTICAL PROCEDURE,		
W70-02801	05A	
WATER POLLUTION SOURCES		
LEAD AND OTHER METAL IONS IN UNITED STATES PRECIPITATION,		
W70-02844	05B	
WATER POLLUTION TREATMENT		
INFLUENCE OF pH ON THE ADSORPTION OF AROMATIC ACIDS ON ACTIVATED CARBON,		
W70-02443	05G	
AN EXAMINATION OF NONTREATMENT PLANT ALTERNATIVES IN WATER POLLUTION CONTROL		
W70-02695	05G	
WATER POTENTIAL		
EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS. VI EFFECTS OF THE EXTERNAL OSMOTIC WATER POTENTIAL ON SOLUTE REQUIREMENT, SALT TRANSPORT KINETICS AND GROWTH RATES OF LEAVES,		
W70-02566	02I	
DETERMINATIONS OF LEAF AND FRUIT WATER POTENTIAL WITH A PRESSURE CHAMBER,		
W70-02568	02I	
WATER PROPERTIES		
PROTON MAGNETIC RESONANCE SPECTRUM OF POLYWATER,		
W70-02617	01A	
POLYWATER PROTON NUCLEAR MAGNETIC RESONANCE SPECTRUM,		
W70-02618	01A	
SUPERDENSE WATER ICE,		
W70-02619	02C	
WATER PURIFICATION		
CLEAN STREAMS LAW.		
W70-02832	05G	
WATER QUALITY		
SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK,		
W70-02631	04C	
VALUE OF DESALTED WATER FOR IRRIGATION,		
W70-02632	03C	
SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS,		
W70-02724	04C	
SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL,		
W70-02729	02G	
ECOLOGY OF SELECTED AQUATIC BACTERIA IN THE SNAKE RIVER,		
W70-02762	05C	
IMPOUNDMENT INFLUENCES ON WATER QUALITY,		
W70-02785	05G	
WATER QUALITY CONTROL		
INDUSTRIAL WASTES.		
W70-02548	06E	
DOMESTIC WATER SUPPLIES.		
W70-02550	05F	
AN EXAMINATION OF NONTREATMENT PLANT ALTERNATIVES IN WATER POLLUTION CONTROL		
W70-02695	05G	
WATER QUALITY MANAGEMENT		
PLANNING AND PROVIDING AN ADEQUATE SUPPLY OF WATER FOR ORANGE COUNTY, CALIFORNIA,		
W70-02487	02L	
THE CHALLENGE OF WATER MANAGEMENT ORANGE COUNTY WATER DISTRICT, CALIFORNIA,		
W70-02489	02L	
THE HYDROGEOLOGIC SETTING IN LOS ANGELES COUNTY, CALIFORNIA,		
W70-02490	02L	
THE AMELIORATION OR PREVENTION OF SALT-WATER INTRUSION IN AQUIFERS - EXPERIENCE IN LOS ANGELES COUNTY, CALIFORNIA,		
W70-02491	02L	
WATER REPELLENT SOILS		
WATER REPELLENT SOILS A WORLDWIDE CONCERN IN MANAGEMENT OF SOIL AND VEGETATION,		
W70-02686	04A	
WATER REQUIREMENTS		
WATER REQUIREMENTS OF LAWNGRASS,		
W70-02562	02D	
WATER RESOURCES		
WATER FOR INDUSTRIAL DEVELOPMENT IN COVINGTON, JEFFERSON, DAVIS, LAMAR, LAWRENCE, MARION, AND WALTHALL COUNTIES, MISSISSIPPI,		
W70-02478	03E	
WATER IN THE KAHUKU AREA, OAHU, HAWAII,		
W70-02623	03B	
BIG BLACK RIVER, MISSISSIPPI COMPREHENSIVE BASIN STUDY - ANNEX F. GEOLOGY AND WATER RESOURCES,		
W70-02672	02E	
GEOLOGY AND GROUNDWATER RESOURCES OF CASS COUNTY, NORTH DAKOTA PART 3,		
W70-02675	02F	
WATER RESOURCES DEVELOPMENT		
FUTURE OF GROUND WATER IN AFRICAN SAHARA DESERT,		
W70-02452	02F	
CONSTRUCTION OF THE KRASNAYARSK RESERVOIR AND ITS SHORE DEVELOPMENT (RUSSIAN),		
W70-02480	08A	
A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967,		
W70-02495	06B	
REMARKS BY CONGRESSMAN WILLIAM C. CRAMER BEFORE THE 56TH ANNUAL CONVENTION, NATIONAL RIVERS AND HARBORS CONGRESS.		
W70-02513	05G	
WATER CONSERVATION AND RECLAMATION FUND.		
W70-02518	05G	
LEASING STATE FORESTS FOR WATER POWER.		
W70-02527	06E	
BRANDYWINE RIVER VALLEY COMPACT.		
W70-02541	06B	
WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN PENNSYLVANIA.		
W70-02644	04A	
WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN NEW YORK.		
W70-02645	04A	
CONSERVATION ACT.		
W70-02816	03D	
WATER RESOURCES RESEARCH		
A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967,		
W70-02495	06B	
WATER REUSE		
WATER CONSERVATION AND RECLAMATION FUND.		
W70-02518	05G	
OPTIMIZING SALVAGEABLE WATER RESOURCES IN A SEMI-ARID INLAND BASIN,		
W70-02745	03C	
WATER RIGHTS		
ALLOCATIVE IMPACTS OF FEDERAL AND STATE WATER DEVELOPMENT LAW,		
W70-02736	06E	
WATER SOURCES		
DOMESTIC WATER SUPPLIES.		
W70-02550	05F	
GEOCHEMISTRY AND ORIGIN OF FORMATION WATERS IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. STABLE ISOTOPES OF HYDROGEN AND OXYGEN,		
W70-02628	02K	
WATER SPREADING		
INFILTRATION OF WATER INTO NONUNIFORM SOIL,		
W70-02447	02G	
FACTORS DETERMINING THE HYDRAULIC CONDUCTIVITY OF RED MEDITERRANEAN SOILS AND DERIVED TYPES,		
W70-02558	02G	
WATER STRUCTURE		
PROTON MAGNETIC RESONANCE SPECTRUM OF POLYWATER,		
W70-02617	01A	
POLYWATER PROTON NUCLEAR MAGNETIC RESONANCE SPECTRUM,		
W70-02618	01A	
SUPERDENSE WATER ICE,		
W70-02619	02C	
WATER SUPPLY		
POLLUTION OF DRINKING WATER.		
W70-02522	05F	
CITIES OF THE SECOND CLASS POWERS RELATING TO LEVEES, FERRIES, WHARVES, CHANNELS, PIERS, AND INFLUENT PIPES.		
W70-02525	04A	
BRANDYWINE RIVER VALLEY COMPACT.		
W70-02541	06B	
DOMESTIC WATER SUPPLIES.		
W70-02550	05F	
RATE AND DIRECTION OF GROUNDWATER CIRCULATION IN CLOSE SPACED BEDROCK AND GRAVEL WELLS UNDER NON-SYNCHRONOUS PUMPING TIME AND RATES,		
W70-02735	04B	
WATER TEMPERATURE		
EFFECT OF INTAKE ELEVATION AND OPERATION ON WATER TEMPERATURE,		

SUBJECT INDEX

WAT- A			
W70-02456	08B	W70-02678	05C
SPRINKLER IRRIGATION SPRAY TEMPERATURES, W70-02563	03F	WILDLIFE FISH AND GAME. W70-02837	06E
TEMPERATURE FLUCTUATIONS SPECTRA IN THE SEA SURFACE LAYER (RUSSIAN), W70-02647	02L	WILDLIFE CONSERVATION FISH AND GAME LAWS - GENERAL PROVISIONS. W70-02589	06E
WATER TEMPERATURE FLUCTUATIONS TEMPERATURE FLUCTUATIONS SPECTRA IN THE SEA SURFACE LAYER (RUSSIAN), W70-02647	02L	WILDLIFE CONSERVATION. W70-02835	06E
WATER TRANSFER DESERTS . THE PROBLEM OF WATER IN ARID LANDS, W70-02561	02A	WILDLIFE MANAGEMENT FISH AND GAME LAWS - GENERAL PROVISIONS. W70-02589	06E
ALLOCATIVE IMPACTS OF FEDERAL AND STATE WATER DEVELOPMENT LAW, W70-02736	06E	WILDLIFE REFUGE CONSERVATION AND CONTROL OF AQUATIC PLANTS AND FISH. W70-02838	04A
WATER TREATMENT HYDROBIOLOGICAL CONTROL OF THE TREATMENT OF WASTE WATERS IN ACCUMULATION PONDS (CZECH), W70-02793	05B	WINDS SUSPENDED SEDIMENTS UNDER TURBULENT CONDITIONS (RUSSIAN). W70-02461	02J
WATER WELLS UNDERGROUND WATER DEVELOPMENT. W70-02530	06E	WINNISQUAM LAKE PHYTOPLANKTON FLORA OF NEWFOUND AND WINNISQUAM LAKES, NEW HAMPSHIRE, W70-02764	05C
FREE WATER FLOW TO ROWS OF WELLS (RUSSIAN), W70-02657	02F	WISCONSIN REGULATION OF HUNTING AND FISHING IN INTERSTATE WATERS. W70-02502	06E
WATER YIELD RATE AND DIRECTION OF GROUNDWATER CIRCULATION IN CLOSE - SPACED BEDROCK AND GRAVEL WELLS UNDER NON-SYNCHRONOUS PUMPING TIME AND RATES, W70-02735	04B	MODERN HYDROCARBONS IN TWO WISCONSIN LAKES, W70-02509	02H
WATERCOURSES (LEGAL) CITIES' POWER OVER WATERCOURSES. W70-02524	08A	CONSERVATION OF NATURAL RESOURCES. W70-02587	03D
THE LAW OF SURFACE WATER IN MISSOURI, W70-02578	08A	PUBLIC LANDS AND SWAMPS - SALES - PUBLIC USE. W70-02588	04A
WATERPROOFING WATER REPELLENT SOILS A WORLDWIDE CONCERN IN MANAGEMENT OF SOIL AND VEGETATION, W70-02686	06A	LANDS MAY BE GRANTED OR EXCHANGED TO PROMOTE BOATING. W70-02682	06E
WATERSHEDS (DIVIDES) GLACIAL DRAINAGE DIVIDE IN THE SKAGIT VALLEY, WASHINGTON, W70-02458	02C	FISH AND GAME. W70-02815	06E
WATER-POWER RIGHTS PUBLIC LANDS AND SWAMPS - SALES - PUBLIC USE. W70-02588	04A	CONSERVATION ACT. W70-02816	03D
WAVES (WATER) COMPARISON OF WIND WAVE AND UNIFORM WAVE EFFECTS ON A BEACH, W70-02476	02L	WILDLIFE CONSERVATION. W70-02835	06E
THE TRANSFORMATION OF A SOLITARY WAVE OVER AN UNEVEN BOTTOM, W70-02625	02L	FISH CONSERVATION. W70-02836	05G
GRAVITY WAVES OVER A NON-UNIFORM FLOW, W70-02626	02L	FISH AND GAME. W70-02837	06E
WEIRS TRIANGULAR BROAD-CRESTED WEIR, W70-02449	07B	CONSERVATION AND CONTROL OF AQUATIC PLANTS AND FISH. W70-02838	04A
FLOW BELOW DEEPLY SUBMERGED RECTANGULAR WEIRS, W70-02472	02E	BRIDGES MADE SAFE. W70-02839	06E
A STUDY OF FLOW CONDITIONS IN SHAFT SPILLWAYS, W70-02774	08A	RIVERS LAKES NAVIGABLE WATERS STATE JURISDICTION. W70-02840	06E
WELL FILTERS DETERMINATION OF SPACINGS OF PARALLEL DRAINAGE SECTIONS AND FILTER-WELL SERIES IN OPENCAST MINE DRAINAGES (GERMAN), W70-02674	05G	JURISDICTION OF COUNTIES ON BOUNDARY WATERS. W70-02841	06E
WELL PERMITS UNDERGROUND WATER DEVELOPMENT. W70-02530	06E	POWERS OF THE DEPARTMENT OF RESOURCE DEVELOPMENT. W70-02842	04A
WESTERN U IRRIGATION IN ARID LANDS, W70-02559	03F	X-RAY FLUORESCENCE ANALYSIS OF TRACE ELEMENTS IN WATER. W70-02768	05A
DESERTS THE PROBLEM OF WATER IN ARID LANDS, W70-02561	02A	YELLOW ORGANIC MATTER AN INVESTIGATION OF THE STRUCTURAL CHEMISTRY OF YELLOW ORGANIC MATTER IN FRESH WATER. W70-02769	02K
WETLANDS SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK, W70-02631	04C	ZINC RADIOISOTOPES SIMULTANEOUS DETERMINATION OF ZN-65-30 AND P-32-15 IN SHELLFISH BY RADIOCHEMICAL TECHNIQUES. W70-02796	05A
WFT-BULB TEMPERATURE SPRINKLER IRRIGATION SPRAY TEMPERATURES, W70-02563	03F	ZONING SOME EXPERIENCE IN THE STUDY OF THE DYNAMICS OF A BENTHIC WATER LAYER IN THE NEAR-SHORE ZONE OF RESERVOIRS (RUSSIAN). W70-02463	02H
NEWANTIC RIVER THE ECOLOGY OF THE YOUNG FISHES OF THE NEWANTIC RIVER- ESTUARY,		ZOOPLANKTON PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA, W70-02766	05C
		PHOSPHORUS EXCRETION AND BODY SIZE IN MARINE ANIMALS MICROZOOPLANKTON AND NUTRIENT REGENERATION, W70-02791	05C
		AEROBIC PROCESSES ENERGY CONCEPTS OF AEROBIC MICROBIAL METABOLISM, W70-02613	05D

AUTHOR INDEX

ABDEL-VAKHAB, M. AMER FREE WATER FLOW TO ROWS OF WELLS (RUSSIAN), W70-02657	02F	POREWATER PRIMARY PRODUCTION BY A BLUE-GREEN ALGA OF BACTERIAL SIZE, W70-02508	02H
ABRAHAM, GERRIT JETS WITH NEGATIVE BUOYANCY IN HOMOGENEOUS FLUID, W70-02715	02E	BENDER, DONALD L. DETERMINATION OF FLOWS FOR UNGAGED STREAMS, W70-02748	02A
ABSHAYEV, M. T. SCATTERING AND ATTENUATION OF RADIATION BY WATER-FILMED HAIL (RUSSIAN), W70-02659	02C	BENNETT, H. D. ALGAE IN RELATION TO MINERAL WATER, W70-02770	05C
AHMED, NAZEER NONLINEAR FLOW IN POROUS MEDIA, W70-02464	02F	BENNETT, R. R. PLANNING FOR POWER - A LOOK AT TOMORROW'S STATION SIZES, W70-02740	08C
AHUJA, L. D. GERMINATION STUDIES OF PERENNIAL GRASS SEEDS, W70-02552	02I	BENSON, ERUCE B. SOLUBILITIES OF NITROGEN, OXYGEN, AND ARGON IN DISTILLED WATER, W70-02701	02K
AITKEN, JANET M. RELATION OF BEDROCK FRACTURE SYSTEMS TO UNDERGROUND WATER SUPPLIES IN THE STAFFORD SPRINGS, SOUTH CONVENTRY, SPRING HILL, AND WESTFORD QUADRANGLES, W70-02756	02F	BEREND, J. E. FACTORS DETERMINING THE HYDRAULIC CONDUCTIVITY OF RED MEDITERRANEAN SOILS AND DERIVED TYPES, W70-02558	02G
ALAM, A. M. Z. FRICTION FACTORS FOR FLOW IN SAND-BED CHANNELS, W70-02461	02J	BEVERIDGE, M. DAVID THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA, W70-02479	03F
ALDON, EARL F. ALKALI SACATON SEEDLINGS GERMINATION AND SURVIVAL IN AN AGAR AND SOIL MEDIUM, W70-02685	04A	BHATI, G. N. STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GRASS AND FORAGE PRODUCTION OF DHARAN (CENCHRUS CILIARIS) AND SEWAN (LASIURUS SINDICUS) PASTURES IN THE ESTABLISHMENT YEAR, W70-02554	03F
ALFORD, JIMMIE M. SLUDGE DISPOSAL EXPERIENCES AT NORTH LITTLE ROCK, ARKANSAS, W70-02616	05D	BHIMAYA, C. P. GERMINATION STUDIES OF PERENNIAL GRASS SEEDS, W70-02552	02I
AMMAR, DR. ENG. R. A. HISTORICAL, FIELD AND EXPERIMENTAL STUDIES OF THE SUEZ CANAL BANK PROTECTION, W70-02698	08A	BIERHUIZEN, J. P. A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967, W70-02495	06B
AMOROCHE, J. GENERALIZED ANALYSIS OF SMALL WATERSHED RESPONSES, W70-02763	02A	BINDLOSS, M. E. FRESHWATER PRIMARY PRODUCTION BY A BLUE-GREEN ALGA OF BACTERIAL SIZE, W70-02508	02H
ANDERSON, JOHN M. INFLUENCE OF STARVATION ON SELECTED TEMPERATURE OF SOME SALMONIDS, W70-02706	05C	BINNIE, A. M. AIR ENTRAINMENT BY FLOWING WATER UNDER REDUCED ATMOSPHERIC PRESSURE, W70-02474	02E
ATKINSON, LARRY P. PARTICULATE ALUMINUM AND IRON IN SEA WATER OFF THE SOUTHEASTERN COAST OF THE UNITED STATES, W70-02630	02K	BISHOP, A. A. EXPRESSING IRRIGATION EFFICIENCY IN TERMS OF APPLICATION TIME, INTAKE AND WATER ADVANCE CONSTANTS, W70-02556	03F
BAILLEY-WATTS, A. E. FRESHWATER PRIMARY PRODUCTION BY A BLUE-GREEN ALGA OF BACTERIAL SIZE, W70-02508	02H	BISHOP, D. M. SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS, W70-02724	04C
BAIM, RICHARD C., JR. ALGAL GROWTH ASSESSMENTS BY FLUORESCENCE TECHNIQUES, W70-02777	05A	BLENCH, THOMAS COORDINATION IN MOBILE-BED HYDRAULICS, W70-02463	08B
BALAKRISHMAN, S. NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- III. DENITRIFICATION IN THE MODIFIED ACTIVATED SLUDGE PROCESS, W70-02607	05D	BOLSENKA, S. J. RIVER ICE JAMS - A LITERATURE REVIEW, W70-02494	02C
BALAKRISHNAN, S. NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- II. NITRIFICATION IN TRICKLING FILTERS, W70-02604	05D	BOND, HOWARD W. CORRELATION OF STRUCTURE VS ACTIVITY OF POLLUTANTS OF FRESH WATER, W70-02753	05C
BANDYOPADHYA, M. FREQUENCY ANALYSIS OF RAINFALL INTENSITIES FOR CALCUTTA, W70-02634	02B	BOOKMAN, MAX LEGAL AND ECONOMIC ASPECTS OF SALT-WATER ENCROACHMENT INTO COASTAL AQUIFERS, W70-02492	02L
BANERJI, SHANKHA K. EFFECT OF BORON ON BIOLOGICAL WASTE TREATMENT, W70-02734	05D	BOSTWICK, C. D. THE EFFECT OF Elevated TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE, W70-02710	05D
BARR, DAVID IAN HUNTER A HYDRAULIC MODEL STUDY OF HEAT DISSIPATION AT KINCARDINE POWER STATION, W70-02717	05B	BOUWER, HERMAN INFILTRATION OF WATER INTO NONUNIFORM SOIL, W70-02447	02G
BATES, MATARD E. MEASUREMENT OF EVAPOTRANSPIRATION IN LOWLAND VEGETATION, W70-02733	02D	BOWERS, C. EDWARD FLUCTUATING PRESSURES IN SPILLWAY STILLING BASINS, W70-02457	08B
BATURIN, G. E. SOME EXPERIENCE IN THE DEVELOPMENT OF LAND IN THE NEW IRRIGATION ZONE IN THE GOLODNAYA STEPPE (RUSSIAN), W70-02648	03F	BRADY, PAUL M. A PRELIMINARY ECOLOGICAL SURVEY OF THE WATER RESOURCES AND LAND USE PATTERNS OF THE DISMAL SWAMP AREA OF VIRGINIA, W70-02746	06G
BEDFORD, KEITH W. STOCHASTIC BASIS FOR COMPREHENSIVE RIVER BASIN PLANNING PHASE I, W70-02681	06A	BRENNER, ER. A. SHORE EROSION AND PROTECTION ST. LAWRENCE RIVER-CANADA, W70-02697	08A
BELCHER, J. H.		BRIDGE, B. J.	

AUTHOR INDEX

BRI-DEP

THE EFFECT OF GYPSUM ON THE WATER STORAGE IN A SANDY LOAM SOIL UNDER AN IRRIGATED PERENNIAL PASTURE, W70-02557	02G	BASIN, W70-02745	03C
BRITTON, DAVID A. A FLUOROMETRIC METHOD FOR DETERMINING TRACE QUANTITIES OF FLUORIDE, W70-02726	07B	COCKBURN, A. DETERMINATION OF DISSOLVED OXYGEN BY THE WINKLER METHOD AND THE SOLUBILITY OF OXYGEN IN PURE WATER AND SEA WATER, W70-02705	02K
A FLUOROMETRIC DETERMINATION OF IODIDE ION, W70-02727	07B	COLE, CHARLES F. THE ECOLOGY OF THE YOUNG FISHES OF THE NEWFOUNDLAND RIVER ESTUARY, W70-02678	05C
FLUOROMETRIC DETERMINATION OF OXALATE ION, W70-02728	07B	CONNAN, R. A. COMPACT ACTIVATED-SLUDGE TREATMENT OF COMBINED PETROCHEMICAL MUNICIPAL WASTE, W70-02600	05D
BROOKS, NORMAN H. DISCHARGE OF SEWAGE EFFLUENT FROM A LINE SOURCE INTO A STRATIFIED OCEAN, W70-02714	05D	COOGAN, FRANK J. TREATMENT OF KRAFT MILL WASTES WITH A PLASTIC MEDIA TRICKLING FILTER, W70-02606	05D
BROWN, DONALD A. INTERACTION OF INORGANIC AND ORGANIC FERTILIZER MATERIALS WITH PESTICIDES AS RELATED TO WATER QUALITY IN SOILS, W70-02761	05B	COOKE, LLOYD M. CLEANING OUR ENVIRONMENT - THE CHEMICAL BASIS FOR ACTION, W70-02640	05G
BROWN, L. R. THE EFFECT OF Elevated TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE, W70-02710	05D	CRAWFORD, CLAUDE C. RESPIRATION CORRECTIONS FOR BACTERIAL UPTAKE OF DISSOLVED ORGANIC COMPOUNDS IN NATURAL WATERS, W70-02641	05A
BRUINGTON, ARTHUR E. THE AMELIORATION OR PREVENTION OF SALT-WATER INTRUSION IN AQUIFERS - EXPERIENCE IN LOS ANGELES COUNTY, CALIFORNIA, W70-02491	02L	CREAGH, J. P. COMPACT ACTIVATED-SLUDGE TREATMENT OF COMBINED PETROCHEMICAL MUNICIPAL WASTE, W70-02600	05D
BUELL, MURRAY F. MEASUREMENT OF EVAPOTRANSPIRATION IN LOWLAND VEGETATION, W70-02733	02D	CROOKE, HOWARD W. PLANNING AND PROVIDING AN ADEQUATE SUPPLY OF WATER FOR ORANGE COUNTY, CALIFORNIA, W70-02487	02L
BURKHEAD, CARL E. ANALOG SIMULATION OF ACTIVATED SLUDGE SYSTEMS, W70-02608	05D	CULBERTSON, JAMES K. HYDROGRAPHIC AND SEDIMENTATION SURVEY OF KAJAKAI RESERVOIR, AFGHANISTAN, W70-02669	02J
ENERGY CONCEPTS OF AEROBIC MICROBIAL METABOLISM, W70-02613	05D	DALEY, JAMES G. THE DETERMINATION OF THE ENGINEERING THERMO-PHYSICAL PROPERTIES OF SOLUTIONS CONTAINING DISSOLVED SOLIDS, W70-02749	02K
BYBKA, V. G. SOME EXPERIENCE IN THE STUDY OF THE DYNAMICS OF A BENTHONIC WATER LAYER IN THE NEAR-SHORE ZONE OF RESERVOIRS (RUSSIAN), W70-02483	02H	DAULAY, H. S. STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GROWTH AND FORAGE PRODUCTION OF DHAMAN (<i>CENCHRUS CILIARIS</i>) AND SEWAN (<i>LASIOURUS SINDICUS</i>) PASTURES IN THE ESTABLISHMENT YEAR, W70-02554	03F
CANTER, HILDA M. THE IMPORTANCE OF PROTOZOA IN CONTROLLING THE ABUNDANCE OF PLANKTONIC ALGAE IN LAKES, W70-02500	02H	DAVIS, LAWRENCE O. THE LAW OF SURFACE WATER IN MISSOURI, W70-02577	04A
CARPENTER, JAMES H. NEW MEASUREMENTS OF OXYGEN SOLUBILITY IN PURE AND NATURAL WATER, W70-02712	02K	W70-02578	04A
CARRITT, D. E. NEW TABLES FOR OXYGEN SATURATION OF SEAWATER, W70-02704	01B	W70-02579	04A
CARROLL, JOSEPH L. INLAND WATERWAY TRANSPORTATION, STUDIES IN PUBLIC AND PRIVATE MANAGEMENT AND INVESTMENT DECISIONS, W70-02700	06B	W70-02580	04A
CARSTENS, H. B. A STUDY OF FLOW CONDITIONS IN SHAFT SPILLWAYS, W70-02774	08A	W70-02581	04A
CECCATO, E. D. DETERMINATIONS OF LEAF AND FRUIT WATER POTENTIAL WITH A PRESSURE CHAMBER, W70-02568	02I	W70-02582	04A
CHAKRABORTY, A. K. STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GROWTH AND FORAGE PRODUCTION OF DHAMAN (<i>CENCHRUS CILIARIS</i>) AND SEWAN (<i>LASIOURUS SINDICUS</i>) PASTURES IN THE ESTABLISHMENT YEAR, W70-02554	03F	W70-02583	04A
CHAMBERLIN, W. S. WESTERN ELECTRIC BUILDS MODERN PLANT FOR TREATING METAL FINISHING WASTES, W70-02601	05D	DEBANO, L. F. WATER REPELLENT SOILS A WORLDWIDE CONCERN IN MANAGEMENT OF SOIL AND VEGETATION, W70-02686	04A
CHAUDHURI, MALAY VIRUS REMOVAL BY CHEMICAL COAGULATION, W70-02767	05P	DEBOER, DARRELL W. DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE SIMULATION OF PLATLAND WATERSHED HYDRAULICS, W70-02676	02G
CHRISTIE, A. E. EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES, W70-02792	05C	DREVEY, EDWARD S., JR. THE OBILITERATION OF THE HYPOLIMNION, W70-02797	05C
NUTRIENT-PHYTOPLANKTON RELATIONSHIPS IN EIGHT SOUTHERN ONTARIO LAKES, W70-02795	05C	DEFAZIO, FRANK G. OPEN-CHANNEL SURGE SIMULATION BY DIGITAL COMPUTER, W70-02459	08B
CHUDIBA, HENRYK CLADOPHORA GLomerata AND CONCOMITANT ALGAE IN THE RIVER SKAWA. DISTRIBUTION AND CONDITIONS OF APPEARANCE, W70-02784	05C	DEGEE, MYRON W. MEASURING SUBSURFACE SPRING FLOW WITH RADIOTRACERS, W70-02637	07B
CLYNE, W. OPTIMIZING SALVAGEABLE WATER RESOURCES IN A SEMI-ARID INLAND		DELLBRE, JACQUES H. FORTEAN-BYDRO, W70-02453	07C
		DELSEMME, A. H. SUPERDENSE WATER ICE, W70-02619	02C
		DELUISE, FRANK J. IRON AND MANGANESE REMOVAL FROM SHALLOW GROUNDWATER SUPPLIES, W70-02755	02F
		DEPRATER, B. L. PHOSPHATE REMOVAL AT FORT WORTH, TEXAS,	05F

AUTHOR INDEX

DEP-HAB

W70-02596	05D	PUMPING TIME AND RATES, W70-02735	04B
DRAKE, CHARLES H. ECOLOGY OF SELECTED AQUATIC BACTERIA IN THE SNAKE RIVER, W70-02762	05C	FRIESEN, IRVING GEOCHEMISTRY AND ORIGIN OF FORMATION WATERS IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. STABLE ISOTOPES OF HYDROGEN AND OXYGEN, W70-02628	02K
DREGNE, HAROLD E. SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL, W70-02729	02G	FULLER, GEORGE C. CORRELATION OF STRUCTURE VS ACTIVITY OF POLLUTANTS OF FRESH WATER, W70-02753	05C
DUCKSTEIN, LUCIEN OPERATIONS RESEARCH STUDY OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT OF THE TUCSON BASIN, W70-02680	06A	GALAL, HEND A. SOLUBILITY OF ATMOSPHERIC OXYGEN IN WATER, W70-02702	02K
DUNBAR, RICHARD F. DOMES PROTECT TRICKLING FILTERS, W70-02615	05D	GALEGAR, WILLIAM C. MEASURING SUBSURFACE SPRING FLOW WITH RADIOTRACERS, W70-02637	07B
DYER, K. R. LINEAR EROSIONAL FURROWS IN SOUTHAMPTON WATER, W70-02445	02J	GACKAE, SURESH A. BATCE ASSAYS FOR DETERMINATION OF ALgal GROWTH POTENTIAL, W70-02778	05A
ECKENFELDER, W. W. NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- III. DENITRIFICATION IN THE MODIFIED ACTIVATED SLUDGE PROCESS, W70-02607	05D	GARCIA-BENGOCHEA, J. I. DEEP WELL DISPOSAL OF WASTEWATERS IN SALINE AQUIFERS OF SOUTH FLORIDA, W70-02468	05E
ECKENFELDER, W. W., JR. NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- II. NITRIFICATION IN TRICKLING FILTERS, W70-02604	05D	GAUR, I. D. PHOTOSOCIOLOGICAL VARIATIONS IN FLORISTIC COMPOSITION OF THE VEGETATION IN THE ARID ZONE I. MONSONAL VEGETATION OF THE ALLUVIAL PLAINS, W70-02553	02I
EISENBUD, MERRIL WATER QUALITY IN INDUSTRIAL AREAS PROFILE OF A RIVER, W70-02493	05C	GETZEN, FOREST W. INFLUENCE OF PH ON THE ADSORPTION OF AROMATIC ACIDS ON ACTIVATED CARBON, W70-02443	05G
ELDER, REX A. EFFECT OF INTAKE ELEVATION AND OPERATION ON WATER TEMPERATURE, W70-02456	08B	GILL, DOUGLAS R. THE USE OF STREAM CHANNELS TO DELIVER STORED WATER THE POSSIBILITY OF INTERFERENCE BY THIRD PARTIES, W70-02765	06E
ENGELBRECHT, RICHARD S. VIRUS REMOVAL BY CHEMICAL COAGULATION, W70-02767	05F	GOMM, F. B. RANGE SEEDING PROBLEMS AND RESEARCH IN THE PINON-JUNIPER WOODLAND TYPE OF SOUTHWESTERN UNITED STATES, W70-02555	04D
PARR, W. A. SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS, W70-02724	04C	GRAFTON, ROBERT SALT-WATER INTRUSION IN SOUTHEASTERN FLORIDA, W70-02486	02L
PELDECK, GEORGE T., JR. AN INVESTIGATION OF THE STRUCTURAL CHEMISTRY OF YELLOW ORGANIC MATTER IN FRESH WATER, W70-02769	02K	GRAULICH, B. P. EXPERIMENTAL PROBLEMS ASSOCIATED WITH THE TESTING OF SURFACE AERATION EQUIPMENT, W70-02612	05D
PERNELIUS, W. A. VALUE OF DESALTED WATER FOR IRRIGATION, W70-02632	03C	GRAY, FRED R. COOLING WATER STUDIES AT ELECTRIC POWER STATION, W70-02713	05B
FILATOVA, L. N. A METHOD FOR THE DETERMINATION OF SNOW RESOURCES IN A MOUNTAIN BASIN (RUSSIAN), W70-02649	02C	GRAY, S. S. COMBATING POLLUTION CREATED BY OIL SPILLS, VOLUME I METHODS, W70-02744	05G
TOTAL SUMMER EVAPORATION IN THE CENTRAL MOUNTAIN BELT OF TRANSILIAN ALATAU AND THE EFFECT OF SLOPE EXPOSURE ON EVAPORATION (RUSSIAN), W70-02651	02D	GREENKORN, R. A. AN INVESTIGATION OF THE FLOW REGIME FOR HELE-SHAW FLOW, W70-02470	08B
FINSTEIN, M. S. ENUMERATION OF AUTOTROPHIC AMMONIUM-OXIDIZING BACTERIA IN MARINE WATERS BY A DIRECT METHOD, W70-02507	07B	GREEN, E. J. NEW TABLES FOR OXYGEN SATURATION OF SEAWATER, W70-02704	01B
FISCHETTI, JOSEPH W. STOCHASTIC BASIS FOR COMPREHENSIVE RIVER BASIN PLANNING PHASE I, W70-02681	06A	GRUENDLING, G. K. PHYTOPLANKTON FLORA OF NEWFOUND AND WINNISQUAM LAKES, NEW HAMPSHIRE, W70-02764	05C
FISHER, DAVID A. THE DETERMINATION OF THE ENGINEERING THERMO-PHYSICAL PROPERTIES OF SOLUTIONS CONTAINING DISSOLVED SOLIDS, W70-02749	02K	PHYTOPLANKTON POPULATIONS IN RELATION TO TROPHIC LEVELS OF LAKES IN NEW HAMPSHIRE, U.S.A. W70-02772	05C
FISHER, HAROLD W. BIOASSAY OF WATER POLLUTANTS WITH CULTURED MAMMALIAN CELLS, W70-02771	05A	GRUNER, EDWARD C. VIGILANCE OVER RESERVOIRS, W70-02639	06E
FOGG, G. E. EXTRACELLULAR PRODUCTS OF PHYTOPLANKTON PHOTOSYNTHESIS, W70-02504	05B	GUTHRIE, RUFUS K. MEMBRANE FILTER-FLUORESCENT-ANTIBODY METHOD FOR DETECTION AND ENUMERATION OF BACTERIA IN WATER, W70-02782	05A
FOK, YU-SI EXPRESSING IRRIGATION EFFICIENCY IN TERMS OF APPLICATION TIME, INTAKE AND WATER ADVANCE CONSTANTS, W70-02556	03F	GUYON, JOHN C. A FLUOROMETRIC METHOD FOR DETERMINING TRACE QUANTITIES OF FLUORIDE, W70-02726	07B
FOSTER, RICHARD L. EFFECTS OF UNIT WEIGHT AND SLOPE ON EROSION, W70-02451	02J	A FLUOROMETRIC DETERMINATION OF IODIDE ION, W70-02727	07B
FOWLER, K. B. AN INVESTIGATION OF FLOODS IN HAWAII THROUGH SEPTEMBER 30, 1968, W70-02471	07C	FLUOROMETRIC DETERMINATION OF OXALATE ION, W70-02728	07B
FRANKEL, L. RATE AND DIRECTION OF GROUNDWATER CIRCULATION IN CLOSE SPACED BEDROCK AND GRAVEL WELLS UNDER NON-SYNCHRONOUS		HAAG, FRED G. STOCHASTIC BASIS FOR COMPREHENSIVE RIVER BASIN PLANNING PHASE I, W70-02681	06A

AUTHOR INDEX

HAMILTON, D. H., JR.		HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, ENGLISH LOOKOUT QUADRANGLE, LOUISIANA-MISSISSIPPI, W70-02498	
NUTRIENT LIMITATION OF SUMMER PHYTOPLANKTON GROWTH IN CATUGA LAKE, W70-02643	05C	02E	
HAMMAD, H. Y.		HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KILM QUADRANGLE, MISSISSIPPI, W70-02499	
FUTURE OF GROUND WATER IN APRICAN SAHARA DESERT, W70-02452	02F	02E	
HAMMER, U. T.		HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUADRANGLES, MISSISSIPPI-ALABAMA, W70-02660	
THE SUCCESSION OF 'BLOOM' SPECIES OF BLUE-GREEN ALGAE AND SOME CAUSAL FACTORS, W70-02684	02H	07C	
HANNIN, C. N.		HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BAY ST. LOUIS QUADRANGLE, MISSISSIPPI, W70-02661	
FLOODS IN TRIPLETT CREEK IN VICINITY OF MOREHEAD, KENTUCKY, W70-02496	02E	07C	
HANSEN, KAJ		HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NW QUADRANGLE, MISSISSIPPI, W70-02662	
LAKE TYPES AND LAKE SEDIMENTS, W70-02683	02H	07C	
HARRECK, G. E., JR.		HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASS CHRISTIAN QUADRANGLE, MISSISSIPPI, W70-02663	
THE EFFECT OF THE ADDITION OF HEAT FROM A POWERPLANT ON THE THERMAL STRUCTURE AND EVAPORATION OF LAKE COLORADO CITY, TEXAS, W70-02703	02D	07C	
HARRISON, ROBERT S.		HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NORTH-SOUTH QUADRANGLES, MISSISSIPPI, W70-02664	
THE MAJARDAB SCHEME, W70-02560	03F	07C	
HART, L. A.		HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, VIDALIA QUADRANGLE, MISSISSIPPI, W70-02665	
A PRELIMINARY ECOLOGICAL SURVEY OF THE WATER RESOURCES AND LAND USE PATTERNS OF THE DISMAL SWAMP AREA OF VIRGINIA, W70-02746	06G	07C	
HATTERLEY-SMITH, G.		HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, WAVELAND-GRAND ISLAND PASS QUADRANGLES, MISSISSIPPI, W70-02666	
DENSITY STRATIFIED LAKES IN NORTHERN ELLESMORE ISLAND, W70-02446	02H	07C	
HATTINGH, W. H. J.		HUGHES, G. H.	
FACTOR ANALYSIS AS AN AID IN AN ECOLOGICAL STUDY OF ANAEROBIC DIGESTION, W70-02594	05D	THE EFFECT OF THE ADDITION OF HEAT FROM A POWERPLANT ON THE THERMAL STRUCTURE AND EVAPORATION OF LAKE COLORADO CITY, TEXAS, W70-02703	
W70-02603	05D	02D	
ANAEROBIC DIGESTION I. THE MICROBIOLOGY OF ANAEROBIC DIGESTION (REVIEW PAPER), W70-02603	05D	HULL, F. C.	
SCALING PROCEDURES FOR MOBILE BED HYDRAULIC MODELS IN TERMS OF SIMILITUDE THEORY, W70-02473	02J	DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02693	
HERBEPTSON, JOHN G.		08G	
SCALING PROCEDURES FOR MOBILE BED HYDRAULIC MODELS IN TERMS OF SIMILITUDE THEORY, W70-02473	02J	W70-02742	08G
HIGER, AARON L.		HUMPHREYS, C. P., JR.	
SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK, W70-02631	04C	WATER FOR INDUSTRIAL DEVELOPMENT IN COVINGTON, JEFFERSON DAVIS, LAMAR, LAWRENCE, MARION, AND WALTHALL COUNTIES, MISSISSIPPI, W70-02478	
HILLS, DAVID J.		03E	
THE METHANE FERMENTATION BETWEEN MESOPHILIC AND THERMOPHILIC TEMPERATURE RANGES, W70-02597	05D	BURST, C. K.	
W70-02597	05D	SHORE EROSION AND PROTECTION ST. LAWRENCE RIVER-CANADA, W70-02697	
HILL, RALPH D., JR.		08A	
BEDLOAD FORMULAS, W70-02671	02J	HURTER, ARTHUR P.	
HIRSCH, A. ADLER		INLAND WATERWAY TRANSPORTATION, STUDIES IN PUBLIC AND PRIVATE MANAGEMENT AND INVESTMENT DECISIONS, W70-02700	
BASIN TRACER CURVES INTERPRETED BY BASIC ANALYTICS, W70-02633	07B	06B	
HITCHON, BRIAN		HUTCHINSON, G. EVELYN	
GEOCHEMISTRY AND ORIGIN OF FORMATION WATERS IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. STABLE ISOTOPES OF HYDROGEN AND OXYGEN, W70-02626	02K	ON THE RELATION BETWEEN THE OXYGEN DEFICIT AND THE PRODUCTIVITY AND TYPOLOGY OF LAKES, W70-02799	
HOARE, E. R.		02B	
IRRIGATION IN ARID LANDS, W70-02559	03F	JAIN, M. P.	
HOBBS, JOHN E.		STUDIES IN THE TECHNIQUES OF FIELD TRIALS IN RANGE LANDS I. SIZE, SHAPE AND ARRANGEMENT OF PLOTS, W70-02551	
RESPIRATION CORRECTIONS FOR BACTERIAL UPTAKE OF DISSOLVED ORGANIC COMPOUNDS IN NATURAL WATERS, W70-02641	05A	03F	
HOOOPER, L. J.		JAKOBSEN, ROBERT J.	
USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES, W70-02709	05B	POLYWATER PROTON NUCLEAR MAGNETIC RESONANCE SPECTRUM, W70-02618	
HORN, J. A.		01A	
PHOSPHATE REMOVAL AT FORT WORTH, TEXAS, W70-02596	05D	JASKE, ROBERT T.	
W70-02596	05D	DENSITY FLOW REGIME OF ROOSEVELT LAKE, W70-02716	
HOWELL, GWYNETH P.		02B	
WATER QUALITY IN INDUSTRIAL AREAS PROFILE OF A RIVER, W70-02493	05C	JASKE, B. T.	
HOWE, CHARLES W.		AN EVALUATION OF THE USE OF SELECTIVE DISCHARGES FROM LAKE ROOSEVELT TO COOL THE COLUMBIA RIVER, W70-02739	
INLAND WATERWAY TRANSPORTATION, STUDIES IN PUBLIC AND PRIVATE MANAGEMENT AND INVESTMENT DECISIONS, W70-02700	06B	05B	
HUDSON, JAMES W.		JAVOID, H. YAQUB	
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, LOGTOWN QUADRANGLE, MISSISSIPPI, W70-02897	02E	INFLUENCE OF STARVATION ON SELECTED TEMPERATURE OF SOME SALMONIDS, W70-02706	
W70-02897	02E	05C	
JENKINS, E.		JENKINS, E.	
KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION, W70-02611	05D	KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION, W70-02611	
JENSEN, M. E.		05D	
SPRINKLER IRRIGATION SPRAY TEMPERATURES, W70-02563	03F	JOHANNES, R. E.	
W70-02563	03F	MEASURING ORGANIC MATTER RETAINED BY AQUATIC INVERTEBRATES, W70-02790	
PHOSPHORUS EXCRETION AND BODY SIZE IN MARINE ANIMALS MICROZOOPHANCTON AND NUTRIENT REGENERATION, W70-02791	05C	05C	
JOHNSON, HOWARD P.		PHOSPHORUS EXCRETION AND BODY SIZE IN MARINE ANIMALS MICROZOOPHANCTON AND NUTRIENT REGENERATION, W70-02791	
DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE SIMULATION OF FLATLAND WATERSHED HYDRAULICS,		05C	

AUTHOR INDEX

JCH-LIA

W70-02676	02G	W70-02493	05C
JOHNSON, M. G. EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES, W70-02792	05C	KOBERG, G. E. THE EFFECT OF THE ADDITION OF HEAT FROM A POWERPLANT ON THE THERMAL STRUCTURE AND EVAPORATION OF LAKE COLORADO CITY, TEXAS, W70-02703	02D
JONES, BERWYN E. A FLUOROMETRIC METHOD FOR DETERMINING TRACE QUANTITIES OF FLUOPIDE, W70-02726	07B	KOH, ROBERT C. Y. DISCHARGE OF SEWAGE EFFLUENT FROM A LINE SOURCE INTO A STRATIFIED OCEAN, W70-02714	05D
JUDSON, SHELDON MODERN HYDROCARBONS IN TWO WISCONSIN LAKES, W70-02509	02H	KOLIPINSKI, MILTON C. SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK, W70-02631	04C
JULIANO, DAVID W. REAERATION MEASUREMENTS IN AN ESTUARY, W70-02636	05G	KOMIMOV, A. M. INDIRECT EVALUATION OF SOME CHARACTERISTICS OF A HYDROLOGICAL REGIME OF RIVERS UNDER CONDITIONS OF EXCESSIVE MOISTURE (RUSSIAN), W70-02482	02A
KARAKI, S. LOCAL SCOUR AROUND BRIDGE PIERS, W70-02462	08B	KOTZKE, J. P. FACTOR ANALYSIS AS AN AID IN AN ECOLOGICAL STUDY OF ANAEROBIC DIGESTION, W70-02594	05D
KARTIMOV, K. A. RESULTS OF ATMOSPHERIC CIRCULATION STUDIES OVER EUROPE, ASIA, AND THE ARCTIC BY RADAR-METEOR TECHNIQUE (RUSSIAN), W70-02655	02B	KRAAI, PETER TRUMAN COMPARISON OF WIND WAVE AND UNIFORM WAVE EFFECTS ON A BEACH, W70-02476	02L
KARY, S. FACTORS DETERMINING THE HYDRAULIC CONDUCTIVITY OF RED MEDITERRANEAN SOILS AND DERIVED TYPES, W70-02558	02G	KROUS, E. S. VALUE OF DESALTED WATER FOR IRRIGATION, W70-02632	03C
KASHCHEYEV, B. L. RESULTS OF ATMOSPHERIC CIRCULATION STUDIES OVER EUROPE, ASIA, AND THE ARCTIC BY RADAR-METEOR TECHNIQUE (RUSSIAN), W70-02655	02B	KRYLOV, S. I. TEMPERATURE FLUCTUATIONS SPECTRA IN THE SEA SURFACE LAYER (RUSSIAN), W70-02647	02L
KASKEVICH, L. N. SUSPENDED SEDIMENTS UNDER TURBULENT CONDITIONS (RUSSIAN), W70-02481	02J	KUMKE, G. W. COMPACT ACTIVATED-SLUDGE TREATMENT OF COMBINED PETROCHEMICAL MUNICIPAL WASTE, W70-02600	05D
KATAYAMA, AKIRA METHODS OF BANK PROTECTION FOR PORT, INLAND WATER-WAY AND RIVER, W70-02699	08A	LADNER, C. M. THE EFFECT OF Elevated TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE, W70-02710	05D
KAZEMI, H. THE INTERPRETATION OF INTERFERENCE TESTS IN NATURALLY FRACTURED RESERVOIRS WITH UNIFORM FRACTURE DISTRIBUTION, W70-02469	08B	LAMPSHAW, F. CHARLES THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA, W70-02479	03F
KENNEDY, J. F. FRICTION FACTORS FOR FLOW IN SAND-BED CHANNELS, W70-02461	02J	LANDBERG, G. G. EXPERIMENTAL PROBLEMS ASSOCIATED WITH THE TESTING OF SURFACE AERATION EQUIPMENT, W70-02612	05D
KEEKES, JOSEPH PUTROTIFICATION AND SENESCENCE IN A GROUP OF PRAIRIE-PARKLAND LAKES IN ALBERTA, CANADA, W70-02802	05C	LAURENSEN, ERIC H. DATA ERROR EFFECTS IN UNIT HYDROGRAPH DERIVATION, W70-02454	07A
KETCHUM, BOSTWICK B. MINERAL NUTRITION OF PHYTOPLANKTON, W70-02804	05C	LAVIN, FRED RANGE SEEDING PROBLEMS AND RESEARCH IN THE PINON-JUNIPER WOODLAND TYPE OF SOUTHWESTERN UNITED STATES, W70-02555	04D
KEYS, J. E. DENSITY STRATIFIED LAKES IN NORTHERN ELLESmere ISLAND, W70-02446	02H	LAWRENCE, C. M. USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES, W70-02709	05B
KIPPLE, W. H. EXPERIMENTAL PROBLEMS ASSOCIATED WITH THE TESTING OF SURFACE AERATION EQUIPMENT, W70-02612	05D	LAZARIDES, V. D. SOME EXPERIENCE IN THE DEVELOPMENT OF LAND IN THE NEW IRRIGATION ZONE IN THE GOLODNAYA STEPPE (RUSSIAN), W70-02648	03F
KIRKHAM, DON GROUND WATER SEEPAGE PATTERNS TO WELLS FOR UNCONFINED FLOW, W70-02759	02G	LAZRUS, ALLAN L. LEAD AND OTHER METAL IONS IN UNITED STATES PRECIPITATION, W70-02444	05B
KISIEL, CESTER C. OPERATIONS RESEARCH STUDY OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT OF THE TUCSON BASIN, W70-02680	06A	LEE, G. FRED SEDIMENTARY PHOSPHORUS IN LAKE CORES--OBSERVATIONS ON DEPOSITIONAL PATTERN IN LAKE MENDOTA, W70-02800	02H
KLAUSTUNG, ROBERT L. GEOLOGY AND GROUNDWATER RESOURCES OF CASS COUNTY, NORTH DAKOTA PART 3, W70-02675	02F	LEE, SEDIMENTARY PHOSPHORUS IN LAKE CORES--ANALYTICAL PROCEDURE, W70-02801	05A
KLEINIG, C. R. THE EFFECT OF GYPSUM ON THE WATER STORAGE IN A SANDY LOAM SOIL UNDER AN IRRIGATED PERENNIAL PASTURE, W70-02557	02G	LEE, R. AN INVESTIGATION OF FLOODS IN HAWAII THROUGH SEPTEMBER 30, 1968, W70-02471	07C
KLEIN, G. STUDY OF A DESIGN-OPTIMIZATION PROCEDURE FOR ION-EXCHANGE AND ADSORPTION COLUMNS, W70-02687	03A	LEGALUY, ROBERT A. SALT WATER CORROSION CONTROL BY ENVIRONMENT MODIFICATION, W70-02689	06G
KLEPPER, BETTY DETERMINATIONS OF LEAF AND FRUIT WATER POTENTIAL WITH A PRESSURE CHAMBER, W70-02568	02I	LEININGER, WM. J. INLAND WATERWAY TRANSPORTATION, STUDIES IN PUBLIC AND PRIVATE MANAGEMENT AND INVESTMENT DECISIONS, W70-02700	06B
KLOTS, CORNELIUS E. SOLUBILITIES OF NITROGEN, OXYGEN, AND ARGON IN DISTILLED WATER, W70-02701	02K	LEVINE, R. P. THE MECHANISM OF PHOTOSYNTHESIS, W70-02503	02K
KWIEPE, THEODORE J. WATER QUALITY IN INDUSTRIAL AREAS PROFILE OF A RIVER,		LIANG, WEN S.	

TRIANGULAR BROAD-CRESTED WEIR, W70-02449	07B	SOME FACTORS AFFECTING RESPIRATION OF PERIPHYTON COMMUNITIES IN LOTIC ENVIRONMENTS, W70-02781	05C
LIPPINCOTT, ELIS R. POLYWATER PROTON NUCLEAR MAGNETIC RESONANCE SPECTRUM, W70-02618	01A	SOME EFFECTS OF CURRENT VELOCITY ON PERIPHYTON COMMUNITIES IN LABORATORY STREAMS, W70-02794	05C
LIU, C. DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02693	08G	MCKINNEY, BOSS E. ENERGY CONCEPTS OF AEROBIC MICROBIAL METABOLISM, W70-02613	05D
W70-02742	08G	MEHAN, W. R. SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS, W70-02724	04C
LLOYD, JAMES D. STOCHASTIC BASIS FOR COMPREHENSIVE RIVER BASIN PLANNING PHASE I, W70-02681	06A	MEI, C. C. THE TRANSFORMATION OF A SOLITARY WAVE OVER AN UNEVEN BOTTOM, W70-02625	02L
LODGE, JAMES P., JR. LEAD AND OTHER METAL IONS IN UNITED STATES PRECIPITATION, W70-02444	05B	MIAN CHANG, WANG INVESTIGATION OF SOIL FREEZING, W70-02750	08E
LORANGE, ELIZABETH LEAD AND OTHER METAL IONS IN UNITED STATES PRECIPITATION, W70-02446	05B	MICHAEL, H. DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02742	08G
LUND, J. W. G. THE IMPORTANCE OF PROTOZOA IN CONTROLLING THE ABUNDANCE OF PLANKTONIC ALGAE IN LAKES, W70-02500	02B	MICHALSKI, M. F. P. EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES, W70-02792	05C
LYSENKO, I. A. RESULTS OF ATMOSPHERIC CIRCULATION STUDIES OVER EUROPE, ASIA, AND THE ARCTIC BY RADAR-METEOR TECHNIQUE (RUSSIAN), W70-02655	02B	MIDDLEBROOKS, E. J. TREATMENT OF KRAFT MILL WASTES WITH A PLASTIC MEDIA TRICKLING FILTER, W70-02606	05D
LYSNE, DAGFINN K. MOVEMENT OF SAND IN TUNNELS, W70-02465	08B	KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION, W70-02611	05D
MADSEN, O. S. THE TRANSFORMATION OF A SOLITARY WAVE OVER AN UNEVEN BOTTOM, W70-02625	02L	MIELKE, JAMES E. DENSITY STRATIFIED LAKES IN NORTHERN ELLISMORE ISLAND, W70-02446	02B
MAGGIOLI, O. J. CONSIDERATIONS ON HYDRAULIC MODELS TO BE EMPLOYED TO STUDY RECIRCULATION INTAKE CONDITIONS OF COOLING WATER IN STEAM POWER STATIONS, W70-02707	05B	MILNE, CLINTON THE HYDROGEOLOGIC SETTING IN LOS ANGELES COUNTY, CALIFORNIA, W70-02490	02L
MALETIC, JOHN T. VALUE OF DESALTED WATER FOR IRRIGATION, W70-02632	03C	MINASHINA, W. G. SOIL FORMATION AND SALT MIGRATION IN THE MURGAB RIVER DELTA, W70-02565	02G
MANSUROVA, YE. P. SOME EXPERIENCE IN EVALUATION OF ATMOSPHERIC PRECIPITATIONS IN THE MOUNTAINS OF TRANSILIAN ALA TAU (RUSSIAN), W70-02650	02B	MONROE, FREDERICK F. OCULTIC ARAGONITE AND QUARTZ SAND LABORATORY COMPARISON UNDER WAVE ACTION, W70-02624	08E
MARCHENKO, A. S. ATTAINABLE ACCURACY OF LINEAR STATISTICAL FORECASTING AND OPTIMAL DIMENSIONS OF THE PREDICTOR (RUSSIAN), W70-02656	02B	MONTANARI, FRANCIS W. PROTECTING LONG ISLAND AQUIFERS AGAINST SALT-WATER INTRUSION, W70-02488	02L
MARCUS, B. D. EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION, W70-02692	08G	MONTGOMERY, H. A. C. DETERMINATION OF DISSOLVED OXYGEN BY THE WINKLER METHOD AND THE SOLUBILITY OF OXYGEN IN PURE WATER AND SEA WATER, W70-02705	02K
MARTIN, C. SAMUEL OPEN-CHANNEL SURGE SIMULATION BY DIGITAL COMPUTER, W70-02459	08B	MOREL-SAYTOUX, HUBERT J. SUITABILITY OF THE UPPER COLORADO RIVER BASIN FOR PRECIPITATION MANAGEMENT, W70-02622	03B
MARTIN, E. C. THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTES, W70-02614	05D	MORRIS, J. CARRELL SOLUBILITY OF ATMOSPHERIC OXYGEN IN WATER, W70-02702	02K
MARTIN, GLEN L. EFFECTS OF UNIT WEIGHT AND SLOPE ON EROSION, W70-02451	02J	MOSS, BRIAN LIMITATION OF ALGAL GROWTH IN SOME CENTRAL AFRICAN WATERS, W70-02646	05C
MATHIESON, A. C. PHYTOPLANKTON FLORA OF NEWFOUND AND WINNISQUA LAKES, NEW HAMPSHIRE, W70-02764	05C	MOUNTJOY, B. W., JR. WESTERN ELECTRIC BUILDS MODERN PLANT FOR TREATING METAL FINISHING WASTES, W70-02601	05D
PHOTOPLANKTON POPULATIONS IN RELATION TO TROPHIC LEVELS OF LAKES IN NEW HAMPSHIRE, U.S.A. W70-02772	05C	MOYER, STANLEY THERMAL DISCHARGES FROM LARGE NUCLEAR PLANT, W70-02635	05B
MATLOCK, W. G. OPTIMIZING SALVAGEABLE WATER RESOURCES IN A SEMI-ARID INLAND BASIN, W70-02745	03C	HUCKEL, DEAN C. WATER REQUIREMENTS OF LAWNGRASS, W70-02562	02D
MCCONNELL, W. J. OPTIMIZING SALVAGEABLE WATER RESOURCES IN A SEMI-ARID INLAND BASIN, W70-02745	03C	MURALIDHAR, D. FLOW BELOW DEEPLY SUBMERGED RECTANGULAR WEIRS, W70-02472	02E
MCDONNELL, G. THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTES, W70-02614	05D	MURAVLEV, G. G. MOUNTAIN AND DESERT LAKES IN SOUTHERN KAZAKHSTAN, THEIR RESOURCES AND METHODS OF ECONOMIC DEVELOPMENT, W70-02568	02H
MCINTIRE, C. DAVID STRUCTURAL CHARACTERISTICS OF BENTHIC ALgal COMMUNITIES IN LABORATORY STREAMS, W70-02780	05C	MURRAY, RAYMOND C. MODERN HYDROCARBONS IN TWO WISCONSIN LAKES, W70-02509	02H
		NUSSALLI, YUSUF G. A STUDY OF FLOW CONDITIONS IN SHAFT SPILLWAYS,	

AUTHOR INDEX

MUS-BAM

W70-02774	08A	W70-02642	02K
MACCI, VITO A. DYNAMIC BEHAVIOR OF SOIL, W70-02751	08E	PASTUHOV, A. V. COMBATING POLLUTION CREATED BY OIL SPILLS, VOLUME I METHODS, W70-02744	05G
NAKAMICHI, HIROSHI SUITABILITY OF THE UPPER COLORADO RIVER BASIN FOR PRECIPITATION MANAGEMENT, W70-02622	03B	PATRIC, J. H. SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS, W70-02724	04C
NALEWAJKO, CZESLAWA EXTRACELLULAR PRODUCTS OF PHYTOPLANKTON PHOTOSYNTHESIS, W70-02504	05B	PECBKUROV, A. F. CALCULATION OF SLOPE STABILITY OF RIVERS AND DRAINAGE CANALS (RUSSIAN), W70-02658	02E
NAVEH, Z. MULTIPLE USE OF MEDITERRANEAN RANGE LANDS NEW APPROACHES TO OLD PROBLEMS, W70-02567	03F	PEREZ-BOSALES, CABELARIO SIMULTANEOUS DETERMINATION OF BASIC GEOMETRICAL CHARACTERISTICS OF POROUS MEDIA, W70-02466	08G
NAZARENKO, M. K. RESULTS OF ATMOSPHERIC CIRCULATION STUDIES OVER EUROPE, ASIA, AND THE ARCTIC BY RADAR-METEOR TECHNIQUE (RUSSIAN), W70-02655	02B	PERKINS, DON HYDROGRAPHIC AND SEDIMENTATION SURVEY OF KAJAKAI RESERVOIR, AFGHANISTAN, W70-02669	02J
NEPAL, R. C. KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION, W70-02611	05D	PESSALL, N. DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02693	08G
NEFF, STUART E. A PRELIMINARY ECOLOGICAL SURVEY OF THE WATER RESOURCES AND LAND USE PATTERNS OF THE DISMAL SWAMP AREA OF VIRGINIA, W70-02746	06G	W70-02742	08G
NELSON, DANIEL J. INTERPRETATION OF RADIONUCLIDE UPTAKE FROM AQUATIC ENVIRONMENTS, W70-02786	05A	PETERSON, PALMER L. STUDY OF EQUIPMENT AND METHODS FOR REMOVING OIL FROM HARBOR WATERS, W70-02725	05G
NURSALL, J. R. EUTROPHICATION AND SENESCENCE IN A GROUP OF PRAIRIE-PARKLAND LAKES IN ALBERTA, CANADA, W70-02802	05C	PETSKO, GREGORY A. PROTON MAGNETIC RESONANCE SPECTRUM OF POLYWATER, W70-02617	01A
OERTLI, J. J. EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS. VI. EFFECTS OF THE EXTERNAL OSMOTIC WATER POTENTIAL ON SOLUTE REQUIREMENT, SALT TRANSPORT KINETICS AND GROWTH RATES OF LEAVES, W70-02566	02I	PHILLIPS, J. L. KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION, W70-02611	05D
ORLYANSKY, A. D. RESULTS OF ATMOSPHERIC CIRCULATION STUDIES OVER EUROPE, ASIA, AND THE ARCTIC BY RADAR-METEOR TECHNIQUE (RUSSIAN), W70-02655	02B	PHINNEY, ERIC H. STUDY OF EQUIPMENT AND METHODS FOR REMOVING OIL FROM HARBOR WATERS, W70-02725	05G
ORTOLANO, LEONARD AN EXAMINATION OF NONTREATMENT PLANT ALTERNATIVES IN WATER POLLUTION CONTROL W70-02695	05G	POCHAPSKY, T. E. A FALLING-PARTICLE CURRENT METER, W70-02670	07B
OSBORN, O. SEA WATER CORROSION TEST PROGRAM, W70-02691	08G	POLENZ, LLOYD M. STUDY OF EQUIPMENT AND METHODS FOR REMOVING OIL FROM HARBOR WATERS, W70-02725	05G
OSWALD, WILLIAM J. BATCH ASSAYS FOR DETERMINATION OF ALGAL GROWTH POTENTIAL, W70-02778	05A	PORCELLA, DONALD B. CONTINUOUS-FLOW (CHEMOSTAT) ASSAYS, W70-02779	05A
OWEN, LANGDON W. THE CHALLENGE OF WATER MANAGEMENT ORANGE COUNTY WATER DISTRICT, CALIFORNIA, W70-02489	02L	POSEY, CHESLEY J. EROSION PREVENTION EXPERIMENTS, W70-02730	04D
O'CONNOR, S. F. WESTERN ELECTRIC BUILDS MODERN PLANT FOR TREATING METAL FINISHING WASTES, W70-02601	05D	PRESCOTT, G. W. OBJECTIONABLE ALGAE WITH REFERENCE TO THE KILLING OF FISH AND OTHER ANIMALS, W70-02803	05C
O'DONNELL, TERENCE DATA ERROR EFFECTS IN UNIT HYDROGRAPH DERIVATION, W70-02454	07A	PROCTOR, DONALD E. EVALUATION OF FACTORS AFFECTING STREAM SELF-PURIFICATION, W70-02758	05G
PAGE, THOMAS F., JR. POLYWATER PROTON NUCLEAR MAGNETIC RESONANCE SPECTRUM, W70-02618	01A	QASHU, B. K. OPTIMIZING SALVAGEABLE WATER RESOURCES IN A SEMI-ARID INLAND BASIN, W70-02745	03C
PATIGE, RUSSELL A. STALACTITE GROWTH BENEATH SEA ICE, W70-02620	02C	QUADE, HENRY W. CLADOCERAN FAUNAS ASSOCIATED WITH AQUATIC MACROPHYTES IN SOME LAKES IN NORTHWESTERN MINNESOTA, W70-02789	02B
PAIR, C. H. SPRINKLER IRRIGATION SPRAY TEMPERATURES, W70-02563	03F	QUILICI, ROBERT E. AXIAL-DISPERSION CONSTANT-PATTERN KINETICS OF ION-EXCHANGE AND ADSORPTION COLUMNS, W70-02688	03A
PANCHARATNAM, S. STUDY OF A DESIGN-OPTIMIZATION PROCEDURE FOR ION-EXCHANGE AND ADSORPTION COLUMNS, W70-02687	03A	RAJARATNAM, N. FLOW BELOW DEEPLY SUBMERGED RECTANGULAR WEIRS, W70-02672	02E
PARKINSON, HAROLD L. VALUE OF DESALTED WATER FOR IRRIGATION, W70-02632	03C	RAMAN, V. FREQUENCY ANALYSIS OF RAINFALL INTENSITIES FOR CALCUTTA, W70-02634	02B
PARK, F. D. R. COMBATING SALT-WATER ENCROACHMENT INTO THE BISCAYNE AQUIFER OF MIAMI, FLORIDA, W70-02485	02L	RABAZANOV, A. SOME EXPERIENCE IN THE DEVELOPMENT OF LAND IN THE NEW IRRIGATION ZONE IN THE GOLODNOY STEPPE (RUSSIAN), W70-02648	03F
PARK, P. KILHO ALKALINITY BUDGET OF THE COLUMBIA RIVER,		RAMSEY, STEVEN G. INLAND WATERWAY TRANSPORTATION, STUDIES IN PUBLIC AND PRIVATE MANAGEMENT AND INVESTMENT DECISIONS, W70-02700	06B

RANEY, EDWARD C. THERMAL DISCHARGES FROM LARGE NUCLEAR PLANT, W70-02635	05B	SCHIEBER, C. F. SEA WATER CORROSION TEST PROGRAM, W70-02691	08G
RAWSON, D. S. A LIMNOLOGICAL COMPARISON OF TWELVE LARGE LAKES IN NORTHERN SASKATCHEWAN, W70-02511	02H	SCHROEDER, EDWARD D. THE METHANE FERMENTATION BETWEEN MESOPHILIC AND THERMOPHILIC TEMPERATURE RANGES, W70-02597	05D
SOME PHYSICAL AND CHEMICAL FACTORS IN THE METABOLISM OF LAKES, W70-02798	02H	SCOTT, DONALD C. PHOSPHORUS BUDGETS OF LAKES SIDNEY LANIER AND HARTWELL, GEORGIA, W70-02752	05G
REEDER, DENNIS J. MEMBRANE FILTER-FLUORESCENT-ANTIBODY METHOD FOR DETECTION AND ENUMERATION OF BACTERIA IN WATER, W70-02782	05A	SERSOON, H. DENSITY STRATIFIED LAKES IN NORTHERN ELLESmere ISLAND, W70-02446	02H
REED, JOHN K. INTERACTION OF PESTICIDE POLLUTANTS AND AQUATIC FOOD-CHAIN ORGANISMS, W70-02677	05C	SETH, M. S. THE INTERPRETATION OF INTERFERENCE TESTS IN NATURALLY FRACTURED RESERVOIRS WITH UNIFORM FRACTURE DISTRIBUTION, W70-02469	08B
RESNICK, S. D. OPTIMIZING SALVAGEABLE WATER RESOURCES IN A SEMI-ARID INLAND BASIN, W70-02785	03C	SETSER, J. L. SIMULTANEOUS DETERMINATION OF ZN-65-30 AND P-32-15 IN SHRIMP BY RADIOCHEMICAL TECHNIQUES, W70-02796	05A
RICE, L. SEA WATER CORROSION TEST PROGRAM, W70-02691	08G	SHAPIRO, DAVID L. ALLOCATIVE IMPACTS OF FEDERAL AND STATE WATER DEVELOPMENT LAW, W70-02736	06E
RICHTER, LOTHAR DETERMINATION OF SPACINGS OF PARALLEL DRAINAGE SECTIONS AND FILTER-WELL SERIES IN OPENCAST MINE DRAINAGES (GERMAN), W70-02674	05G	SHAPIRO, JOSEPH EFFECT OF YELLOW ORGANIC ACIDS ON IRON AND OTHER METALS IN WATER, W70-02505	02K
ROBECK, GORDON G. IMPOUNDMENT INFLUENCES ON WATER QUALITY, W70-02785	05G	SHARPS, JOSEPH A. LATERAL MIGRATION OF THE ARKANSAS RIVER DURING THE QUATERNARY-FOWLER, COLORADO, TO THE COLORADO-KANSAS STATE LINE, W70-02475	02J
ROESSLER, THEODORE THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA, W70-02479	03F	SHATTLES, D. E. WATER FOR INDUSTRIAL DEVELOPMENT IN COVINGTON, JEFFERSON DAVIS, LAMAR, LAWRENCE, MARION, AND WALTHALL COUNTIES, MISSISSIPPI, W70-02478	03E
ROHLICH, GERARD A. NEED FOR ASSAYS, W70-02776	05A	SHEN, E. W. LOCAL SCOUR AROUND BRIDGE PIERS, W70-02462	08B
ROLLINS, FRED R., JR. ULTRASONIC DETECTION OF CALCIUM SULFATE SCALE ON METAL SURFACES, W70-02690	08G	SHIROKOV, V. N. CONSTRUCTION OF THE KRASHNOYARSK RESERVOIR AND ITS SHORE DEVELOPMENT (RUSSIAN), W70-02480	08A
ROSE, VINCENT C. ANALYSIS OF TRACE ELEMENTS IN WATER, W70-02768	05A	SHULITS, SAM BEDLOAD FORMULAS, W70-02671	02J
ROZENPERG, V. I. SCATTERING AND ATTENUATION OF RADIATION BY WATER-FILMED HAIL (RUSSIAN), W70-02659	02C	SIEBERT, H. L. FACTOR ANALYSIS AS AN AID IN AN ECOLOGICAL STUDY OF ANAEROBIC DIGESTION, W70-02594	05D
ROZELL, T. C. SIMULTANEOUS DETERMINATION OF ZN-65-30 AND P-32-15 IN SHRIMP BY RADIOCHEMICAL TECHNIQUES, W70-02796	05A	THE PROTEOLYTIC BACTERIA PRESENT IN THE ANAEROBIC DIGESTION OF RAW SEWAGE SLUDGE, W70-02602	05D
RUSSELL, W. B. SEA WATER CORROSION TEST PROGRAM, W70-02691	08G	SILVERMAN, R. P. EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION, W70-02692	08G
SATOMI, MASAKO MEASURING ORGANIC MATTER RETAINED BY AQUATIC INVERTEBRATES, W70-02790	05C	SIMMONS, GEORGE M. A PRELIMINARY ECOLOGICAL SURVEY OF THE WATER RESOURCES AND LAND USE PATTERNS OF THE DISHAL SWAMP AREA OF VIRGINIA, W70-02746	06G
SATYANARAYAN, Y. PHOTOSOCIOLOGICAL VARIATIONS IN FLORISTIC COMPOSITION OF THE VEGETATION IN THE ARID ZONE I. MONSOONAL VEGETATION OF THE ALLUVIAL PLAINS, W70-02553	02I	SIMONS, MARTIN DESERTS: THE PROBLEM OF WATER IN ARID LANDS, W70-02561	02A
SAUNDERS, GEORGE W. INTERRELATIONS OF DISSOLVED ORGANIC MATTER AND PHYTOPLANKTON, W70-02510	05C	SIMS, G. P. AIR ENTRAINMENT BY FLOWING WATER UNDER REDUCED ATMOSPHERIC PRESSURE, W70-02474	02E
SAWYER, CLAIR N. FERTILIZATION OF LAKES BY AGRICULTURAL AND URBAN DRAINAGE, W70-02787	05B	SINGH, KRISHAN P. THEORETICAL BASEFLOW CURVES, W70-02460	02A
SAZONOV, V. A. SEASONAL FREEZING AND ITS HYDROLOGICAL EFFECT UNDER THE CONDITIONS OF THE NORTHERN SLOPE OF THE TRANSILIAN ALA TAU (RUSSIAN), W70-02653	02C	SLADECEK, V. HYDROBIOLOGICAL CONTROL OF THE TREATMENT OF WASTE WATERS IN ACCUMULATION PONDS (CZECH), W70-02793	05B
SCHULBACH, DR. JAMES C. EFFECTS OF CHLORINATED HYDROCARBON INSECTICIDES ON THE FRESHWATER SHRIMP, W70-02679	05C	SHAYDA, THEODORE J. BUOYANCY AND SINKING CHARACTERISTICS OF FRESHWATER PHYTOPLANKTON, W70-02754	05G
SCHNEIDER, W. R. LOCAL SCOUR AROUND BRIDGE PIERS, W70-02462	08B	SMITH, CLIFFORD D. TRIANGULAR BROAD-CRESTED WEIR, W70-02449	07B
SCHRABER, DIETER BRINE SPRINGS IN THE ZWICKAU-OELSNTZ COAL AREA (GERMAN), W70-02673	05B	SMITH, JOHN D. STUDY OF EQUIPMENT AND METHODS FOR REMOVING OIL FROM HARBOR WATERS,	

AUTHOR INDEX

SMI-VER

W70-02725	05G	
SMITH, R. PRELIMINARY DESIGN OF WASTEWATER TREATMENT SYSTEMS, W70-02610	05D	
SMITH, R. C. AN INVESTIGATION OF THE FLOW REGIME FOR HELE-SHAW FLOW, W70-02470	02B	
SNYDER, GEORGE R. DENSITY FLOW REGIME OF ROOSEVELT LAKE, W70-02716	02H	
SOSEDOV, I. S. SOME EXPERIENCE IN EVALUATION OF ATMOSPHERIC PRECIPITATIONS IN THE MOUNTAINS OF TRANSILIAN ALA TAU (RUSSIAN), W70-02650	02B	
TOTAL SUMMER EVAPORATION IN THE CENTRAL MOUNTAIN BELT OF TRANSILIAN ALATAU AND THE EFFECT OF SLOPE EXPOSURE ON EVAPORATION (RUSSIAN), W70-02651	02D	
FILTRATION PROPERTIES OF THE SOIL OF THE MOUNTAINS ON THE NORTHERN SLOPE OF TRANSILIAN ALA TAU (RUSSIAN), W70-02652	02G	
SEASONAL FREEZING AND ITS HYDROLOGICAL EFFECT UNDER THE CONDITIONS OF THE NORTHERN SLOPE OF THE TRANSILIAN ALA TAU (RUSSIAN), W70-02653	02C	
THE ROLE OF SOLID AND LIQUID PRECIPITATIONS IN RUNOFF FORMATION (RUSSIAN), W70-02654	02C	
SOSEDOV, I. S. A METHOD FOR THE DETERMINATION OF SNOW RESOURCES IN A MOUNTAIN BASIN (RUSSIAN), W70-02649	02C	
SOZONOV, V. A. FILTRATION PROPERTIES OF THE SOIL OF THE MOUNTAINS ON THE NORTHERN SLOPE OF TRANSILIAN ALA TAU (RUSSIAN), W70-02652	02G	
SPENCER, JOHN S. WATER REQUIREMENTS OF LAWNGRASS, W70-02562	02D	
SPITALNIK, J. CONSIDERATIONS ON HYDRAULIC MODELS TO BE EMPLOYED TO STUDY RECIRCULATION INTAKE CONDITIONS OF COOLING WATER IN STEAM POWER STATIONS, W70-02707	05B	
STALL, JOHN B. URBAN RUNOFF BY ROAD RESEARCH LABORATORY METHOD, W70-02467	04C	
STEFANSON, UNNSTEINN PARTICULATE ALUMINUM AND IRON IN SEA WATER OFF THE SOUTHEASTERN COAST OF THE UNITED STATES, W70-02630	02K	
STEIN, J. E. THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTES, W70-02614	05D	
STEPHENSON, BEN J. COOLING WATER STUDIES AT ELECTRIC POWER STATION, W70-02713	05B	
STERN, DANIEL H. PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA, W70-02766	05C	
STERN, MICHELE PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA, W70-02766	05C	
STETSON, A. R. EVALUATION OF TITANIUM-PLATED STEEL IN A CHLORIDE ENVIRONMENT, W70-02781	08G	
STIDD, CHARLES K. LOCAL MOISTURE AND PRECIPITATION, W70-02668	02B	
STUMM, WERNER SOLUBILITY OF ATMOSPHERIC OXYGEN IN WATER, W70-02702	02K	
SUNADA, DANIEL K. NONLINEAR FLOW IN POROUS MEDIA, W70-02464	02F	
SYMONS, JAMES H. IMPOUNDMENT INFLUENCES ON WATER QUALITY, W70-02785	05G	
TAKASAKI, K. J. WATER IN THE KAHLUKU AREA, OAHU, HAWAII, W70-02623	03B	
TAYLOR, R. E.		
TERSTRIEP, MICHAEL L. WATER FOR INDUSTRIAL DEVELOPMENT IN COVINGTON, JEFFERSON DAVIS, LAMAR, LAWRENCE, MARION, AND WALTHALL COUNTIES, MISSISSIPPI, W70-02478	03E	
TERSTRIEP, MICHAEL L. URBAN RUNOFF BY ROAD RESEARCH LABORATORY METHOD, W70-02467	04C	
THIEL, P. C. FACTOR ANALYSIS AS AN AID IN AN ECOLOGICAL STUDY OF ANAEROBIC DIGESTION, W70-02594	05D	
THIEL, P. G. THE EFFECT OF METHANE ANALOGUES ON METHANOGENESIS IN ANAEROBIC DIGESTION, W70-02595	05D	
THIRUMURTHI, D. DESIGN PRINCIPLES OF WASTE STABILIZATION PONDS, W70-02609	05D	
THOMAS, G. W. THE INTERPRETATION OF INTERFERENCE TESTS IN NATURALLY FRACTURED RESERVOIRS WITH UNIFORM FRACTURE DISTRIBUTION, W70-02469	02B	
THOMAS, HAROLD A., JR. AN EXAMINATION OF NONTREATMENT PLANT ALTERNATIVES IN WATER POLLUTION CONTROL W70-02695	05G	
THOM, N. S. DETERMINATION OF DISSOLVED OXYGEN BY THE WINKLER METHOD AND THE SOLUBILITY OF OXYGEN IN PURE WATER AND SEA WATER, W70-02705	02K	
TILTON, RICHARD C. STUDIES ON PHOSPHOROUS TRANSFORMATIONS IN EUTROPHIC LAKES, W70-02747	05C	
TISCHER, R. G. THE EFFECT OF Elevated TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE, W70-02710	05D	
TOEBES, GERRIT H. FORTRAN-HYDRO, W70-02453	07C	
TOERIEN, D. F. FACTOR ANALYSIS AS AN AID IN AN ECOLOGICAL STUDY OF ANAEROBIC DIGESTION, W70-02594	05D	
THE PROTEOLYTIC BACTERIA PRESENT IN THE ANAEROBIC DIGESTION OF RAW SEWAGE SLUDGE, W70-02602	05D	
ANAEROBIC DIGESTION I. THE MICROBIOLOGY OF ANAEROBIC DIGESTION (REVIEW PAPER), W70-02603	05D	
TOUHILL, C. J. THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTES, W70-02614	05D	
TOVEY, RHYL ALFALFA WATER TABLE INVESTIGATIONS, W70-02450	02I	
WATER REQUIREMENTS OF LAWNGRASS, W70-02562	02D	
TSAI, FRANK Y. FLUCTUATING PRESSURES IN SPILLWAY STILLING BASINS, W70-02457	02B	
TSUKAMOTO, W. T. EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION, W70-02692	02G	
UDEN, R VAN KINETICS OF NUTRIENT-LIMITED GROWTH, W70-02783	05C	
VALENCIANO, SANTOS WATER IN THE KAHLUKU AREA, OAHU, HAWAII, W70-02623	03B	
VAN DER BORG, C. A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967, W70-02495	02B	
VAN WIJNGAARDEN, L. GRAVITY WAVES OVER A NON-UNIFORM FLOW, W70-02626	02L	
VELTHUIZEN, H. G. H. GRAVITY WAVES OVER A NON-UNIFORM FLOW, W70-02626	02L	
VERMEULEN, THEODORE AXIAL-DISPERSION CONSTANT-PATTERN KINETICS OF ION-EXCHANGE AND ADSORPTION COLUMNS, W70-02688	03A	
VERMEULEN, T. STUDY OF A DESIGN-OPTIMIZATION PROCEDURE FOR ION-EXCHANGE		

AND ADSORPTION COLUMNS, W70-02687	03A	SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL, W70-02729	02G
VERNON, R. O. DEEP WELL DISPOSAL OF WASTEWATERS IN SALINE AQUIFERS OF SOUTH FLORIDA, W70-02468	05E	WILDER, C. DUKE, JR. A PRELIMINARY ECOLOGICAL SURVEY OF THE WATER RESOURCES AND LAND USE PATTERNS OF THE DISMAL SWAMP AREA OF VIRGINIA, W70-02746	06G
VISSEER, W. C. A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967, W70-02495	06B	WILLIAMS, DONALD H. CHEMISTRY OF THE OXIDANT, FERRATE, ITS INTERACTION WITH SPECIFIC ORGANICS FOUND IN WASTE WATER, W70-02738	05G
VOLKEE, RAYMOND E. NONLINEAR FLOW IN POROUS MEDIA BY FINITE ELEMENTS, W70-02455	02F	WILLIAMS, J. C. SEA WATER CORROSION TEST PROGRAM, W70-02691	08G
WAGNER, J. P. VALUE OF DESALTED WATER FOR IRRIGATION, W70-02632	03C	WILSON, KENNETH V. FLOODS OF JUNE 1, 1967 IN SOUTHWESTERN JACKSON, MISSISSIPPI, W70-02477	02E
WALDBAUM, D. R. THERMODYNAMIC MIXING PROPERTIES OF NaCl LIQUIDS, W70-02627	02K	WILSON, K. V. HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, LOGTOWN QUADRANGLE, MISSISSIPPI, W70-02497	02E
WALKUP, PAUL C. STUDY OF EQUIPMENT AND METHODS FOR REMOVING OIL FROM HARBOR WATERS, W70-02725	05G	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, ENGLISH LOOKOUT QUADRANGLE, LOUISIANA-MISSISSIPPI, W70-02489	02E
WARD, THOMAS M. INFLUENCE OF PH ON THE ADSORPTION OF AROMATIC ACIDS ON ACTIVATED CARBON, W70-02443	05G	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KILEN QUADRANGLE, MISSISSIPPI, W70-02499	02E
WARNOCK, R. V. EVALUATION OF TITANIUM-PLATED STEEL IN A CHLORIDE ENVIRONMENT, W70-02741	08G	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUADRANGLES, MISSISSIPPI-ALABAMA, W70-02660	07C
WASSON, B. E. FLOODS IN MISSISSIPPI-SEPTEMBER 1965 THROUGH SEPTEMBER 1967, W70-02621	02E	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BAY ST. LOUIS QUADRANGLE, MISSISSIPPI, W70-02661	07C
BIG BLACK RIVER, MISSISSIPPI COMPREHENSIVE BASIN STUDY - ANNEX F. GEOLOGY AND WATER RESOURCES, W70-02672	02E	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NW QUADRANGLE, MISSISSIPPI, W70-02662	07C
WATERMAN, WALTER G. PROTECTING LONG ISLAND AQUIFERS AGAINST SALT-WATER INTRUSION, W70-02488	02L	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASS CHRISTIAN QUADRANGLE, MISSISSIPPI, W70-02663	07C
WATSON, KEITH K. ANALYSIS OF INFILTRATION INTO DRAINING POROUS MEDIA, W70-02448	02G	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NORTHE-SOUTH QUADRANGLES, MISSISSIPPI, W70-02664	07C
WEATT, W. D. EXTRACELLULAR PRODUCTS OF PHYTOPLANKTON PHOTOSYNTHESIS, W70-02504	05B	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, VIDALIA QUADRANGLE, MISSISSIPPI, W70-02665	07C
WEBSTER, GEORGE R. ALKALINITY BUDGET OF THE COLUMBIA RIVER, W70-02642	02K	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, WAVELAND-GRAND ISLAND PASS QUADRANGLES, MISSISSIPPI, W70-02666	07C
WECHSLER, A. E. COMBATING POLLUTION CREATED BY OIL SPILLS, VOLUME I METHODS, W70-02744	05G	WIND, G. P. A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967, W70-02495	06B
WEIBEL, SAMUEL R. IMPOUNDMENT INFLUENCES ON WATER QUALITY, W70-02785	05G	WITHEROW, J. L. PHOSPHATE REMOVAL AT FORT WORTH, TEXAS, W70-02596	05D
WEIS, PAUL L. GLACIAL DRAINAGE DIVIDE IN THE SKAGIT VALLEY, WASHINGTON, W70-02458	02C	WOODS, WILLIAM J. CURRENT STUDY IN THE NEUSE RIVER AND ESTUARY OF NORTH CAROLINA, W70-02760	02L
WENGER, A. SUPERDENSE WATER ICE, W70-02619	02C	WOOD, D. J. ANALOG SIMULATION OF ACTIVATED SLUDGE SYSTEMS, W70-02668	05D
WENTZ, DENNIS A. SEDIMENTARY PHOSPHORUS IN LAKE CORES--OBSERVATIONS ON DEPOSITIONAL PATTERN IN LAKE MENDOTA, W70-02800	02B	WRIGHT, CARL D. STABILIZATION OF AN ACTIVATED SLUDGE PLANT, W70-02593	05D
WESCHLER, LOUIS F. A COMPREHENSIVE STUDY OF THE USE TAX AS A MEANS OF ALLOCATION OF WATER RESOURCES IN A CONJUNCTIVE USE SYSTEM, W70-02757	06C	WRIGHT, J. L. SPRINKLER IRRIGATION SPRAY TEMPERATURES, W70-02563	03F
WESSELING, J. A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967, W70-02495	06B	WUNDERLICH, WALTER O. EFFECT OF INTAKE ELEVATION AND OPERATION ON WATER TEMPERATURE, W70-02456	06B
WHISLER, FRANK D. ANALYSIS OF INFILTRATION INTO DRAINING POROUS MEDIA, W70-02448	02G	YAMANOTO, ROY ALKALINITY BUDGET OF THE COLUMBIA RIVER, W70-02642	02K
WHITWORTH, WALTER R. EFFECTS OF SIMULTANEOUS VARIATION OF TEMPERATURE AND DISSOLVED OXYGEN ON THE RESISTANCE OF FISHES TO CONTROLLED POLLUTANTS, W70-02731	05C	YOSHIMURA, SHINKICHI CONTRIBUTIONS TO THE KNOWLEDGE OF NITROGENOUS COMPOUNDS AND PHOSPHATE IN THE LAKE WATERS OF JAPAN, W70-02788	05C
WIERENGA, PETER J.		ZACK, S. I. ENGINEERING ASPECTS OF WASTEWATER CONTRACTS, W70-02605	05D
		ZAUBERT, B. H. REVETMENTS FOR BANK PROTECTION USING VERY ROUGH-SURFACED FERRO-CONCRETE ELEMENTS (FRENCH), W70-02696	08A

ORGANIZATIONAL INDEX

AGRICULTURAL RESEARCH SERVICE, KIMBERLY, IDAHO. SOIL AND WATER CONSERVATION RESEARCH DIV. AND AGRICULTURAL RESEARCH SERVICE, KIMBERLY, IDAHO. SNAKE RIVER RESEARCH CENTER. SPRINKLER IRRIGATION SPRAY TEMPERATURES, W70-02563 03F

AGRICULTURAL RESEARCH SERVICE, PHOENIX, ARIZ. WATER CONSERVATION LAB. INFILTRATION OF WATER INTO NONUNIFORM SOIL, W70-02447 02G

ANALYSIS OF INFILTRATION INTO DRAINING POROUS MEDIA, W70-02448 02G

AGRICULTURAL RESEARCH SERVICE, RENO, NEV. SOIL AND WATER CONSERVATION RESEARCH DIV. ALFALFA WATER TABLE INVESTIGATIONS, W70-02450 02I

AGRICULTURAL RESEARCH SERVICE, WASHINGTON, D.C. CROP RESEARCH DIV. RANGE SEEDING PROBLEMS AND RESEARCH IN THE PINYON-JUNIPER WOODLAND TYPE OF SOUTHWESTERN UNITED STATES, W70-02555 04D

AKADEMIYA NAUK KAZAKHSSKOI SSR, ALMA-ATA. INSTITUT GIDROGEOLOGII I GIDROFIZIKI. A METHOD FOR THE DETERMINATION OF SNOW RESOURCES IN A MOUNTAIN BASIN (RUSSIAN), W70-02649 02C

SOME EXPERIENCE IN EVALUATION OF ATMOSPHERIC PRECIPITATIONS IN THE MOUNTAINS OF TRANSILIAN ALA TAU (RUSSIAN), W70-02650 02B

TOTAL SUMMER EVAPORATION IN THE CENTRAL MOUNTAIN BELT OF TRANSILIAN ALATAU AND THE EFFECT OF SLOPE EXPOSURE ON EVAPORATION (RUSSIAN), W70-02651 02D

FILTRATION PROPERTIES OF THE SOIL OF THE MOUNTAINS ON THE NORTHERN SLOPE OF TRANSILIAN ALA TAU (RUSSIAN), W70-02652 02G

SEASONAL FREEZING AND ITS HYDROLOGICAL EFFECT UNDER THE CONDITIONS OF THE NORTHERN SLOPE OF THE TRANSILIAN ALA TAU (RUSSIAN), W70-02653 02C

THE ROLE OF SOLID AND LIQUID PRECIPITATIONS IN RUNOFF FORMATION (RUSSIAN), W70-02654 02C

AKADEMIYA NAUK SSSR, MOSCOW. POCHVENNYI INSTITUT. SOIL FORMATION AND SALT MIGRATION IN THE MURGAB RIVER DELTA, W70-02565 02G

ALBERTA UNIV., EDMONTON. DEPT. OF CIVIL ENGINEERING. COORDINATION IN MOBILE-BED HYDRAULICS, W70-02463 00B

FLOW BELOW DEEPLY SUBMERGED RECTANGULAR WEIRS, W70-02472 02E

ALEXANDRIA UNIV. (EGYPT). FACULTY OF ENGINEERING. FUTURE OF GROUND WATER IN AFRICAN SAHARA DESERT, W70-02452 02F

ALL-INDIA INST. OF HYGIENE AND PUBLIC HEALTH, CALCUTTA AND CALCUTTA METROPOLITAN PLANNING ORGANIZATION (INDIA). FREQUENCY ANALYSIS OF RAINFALL INTENSITIES FOR CALCUTTA, W70-02634 02B

AMHERST COLL., MASS. DEPT. OF PHYSICS. SOLUBILITIES OF NITROGEN, OXYGEN, AND ARGON IN DISTILLED WATER, W70-02701 02K

ARIZONA UNIV., TUCSON. OPTIMIZING SALVAGEABLE WATER RESOURCES IN A SEMI-ARID INLAND BASIN, W70-02745 03C

ARIZONA WATER RESOURCES RESEARCH CENTER, TUCSON. OPERATIONS RESEARCH STUDY OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT OF THE TUCSON BASIN, W70-02680 06A

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF AGRONOMY. INTERACTION OF INORGANIC AND ORGANIC FERTILIZER MATERIALS WITH PESTICIDES AS RELATED TO WATER QUALITY IN SOILS, W70-02761 05B

ARMY COASTAL ENGINEERING RESEARCH CENTER, WASHINGTON, D.C. OOLITIC ARAGONITE AND QUARTZ SAND LABORATORY COMPARISON UNDER WAVE ACTION, W70-02624 06E

ATLANTIC RICHFIELD CO., DALLAS, TEX. THE INTERPRETATION OF INTERFERENCE TESTS IN NATURALLY FRACTURED RESERVOIRS WITH UNIFORM FRACTURE DISTRIBUTION, W70-02469 00B

BASIN AND FILTER SPECIALTY CO., SHREVEPORT, LA. BASIN TRACER CURVES INTERPRETED BY BASIC ANALYTICS, W70-02633 07B

BATTELLE MEMORIAL INST., COLUMBUS, OHIO AND MARYLAND UNIV., COLLEGE PARK, DEPT. OF CHEMISTRY. POLYWATER PROTON NUCLEAR MAGNETIC RESONANCE SPECTRUM, W70-02618 01A

BATTELLE MEMORIAL INST., RICHLAND, WASH. DEPT. OF ENVIRONMENTAL HEALTH AND ENGINEERING AND BUREAU OF COMMERCIAL FISHERIES, SEATTLE, WASH. FISH PASSAGE RESEARCH PROGRAM.

DENSITY FLOW REGIME OF ROOSEVELT LAKE, W70-02716 02H

BATTELLE MEMORIAL INST., RICHLAND, WASH. PACIFIC NORTHWEST LABS. STUDY OF EQUIPMENT AND METHODS FOR REMOVING OIL FROM HARBOR WATERS, W70-02725 05G

BATTELLE-NORTHWEST, RICHLAND, WASH. PACIFIC NORTHWEST LAB. AN EVALUATION OF THE USE OF SELECTIVE DISCHARGES FROM LAKE ROOSEVELT TO COOL THE COLUMBIA RIVER, W70-02739 05B

BATTELLE-NORTHWEST, RICHLAND, WASH. PACIFIC NORTHWEST LAB. AND METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO, ILL. THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTES, W70-02614 05D

BOOKMAN AND EDMONSTON, GLENDALE, CALIF. LEGAL AND ECONOMIC ASPECTS OF SALT-WATER ENCROACHMENT INTO COASTAL AQUIFERS, W70-02492 02L

BOWLES ENGINEERING CORP., SILVER SPRING, MD. DESIGN OF A COMBINED SEWER FLUIDIC REGULATOR, THE DEVELOPMENT OF BASIC CONFIGURATIONS AND DESIGN CRITERIA FOR APPLICATIONS OF FLUIDS IN SEWER REGULATORS, W70-02773 04A

BUREAU OF RECLAMATION, DENVER, COLO. AND BUREAU OF RECLAMATION, BOULDER CITY, NEV. VALUE OF DESALTED WATER FOR IRRIGATION, W70-02632 03C

CAIRO UNIV. (EGYPT). FREE WATER FLOW TO ROWS OF WELLS (RUSSIAN), W70-02657 02F

CALIFORNIA INST. OF TECH., PASADENA. DEPT. OF CIVIL ENGINEERING. DISCHARGE OF SEWAGE EFFLUENT FROM A LINE SOURCE INTO A STRATIFIED OCEAN, W70-02714 05D

CALIFORNIA UNIV., BERKELEY. COMPARISON OF WIND WAVE AND UNIFORM WAVE EFFECTS ON A BEACH, W70-02476 02L

STUDY OF A DESIGN-OPTIMIZATION PROCEDURE FOR ION-EXCHANGE AND ADSORPTION COLUMNS, W70-02687 03A

AXIAL-DISPERSION CONSTANT-PATTERN KINETICS OF ION-EXCHANGE AND ADSORPTION COLUMNS, W70-02688 03A

CALIFORNIA UNIV., BERKELEY. SANITARY ENGINEERING RESEARCH LAB. KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION, W70-02611 05D

CALIFORNIA UNIV., BERKELEY. SANITARY ENGINEERING RESEARCH LAB. AND PACIFIC NORTHWEST WATER LAB. CORVALLIS, OREG. PROCEEDINGS OF THE EUTROPHICATION-BICSTIMULATION ASSESSMENT WORKSHOP, W70-02775 05A

CALIFORNIA UNIV., BERKELEY. SANITARY ENGINEERING RESEARCH LAB. NEED FOR ASSAYS, W70-02776 05A

CALIFORNIA UNIV., BERKELEY. SANITARY ENGINEERING RESEARCH LAB. BATCH ASSAYS FOR DETERMINATION OF ALGAL GROWTH POTENTIAL, W70-02778 05A

CONTINUOUS-FLOW (CHEMOSTAT) ASSAYS, W70-02779 05A

CALIFORNIA UNIV., DAVIS. GENERALIZED ANALYSIS OF SMALL WATERSHED RESPONSES, W70-02763 02A

CALIFORNIA UNIV., DAVIS. DEPT. OF CIVIL ENGINEERING. THE METHANE FERMENTATION BETWEEN MESOPHILIC AND THERMOPHILIC TEMPERATURE RANGES, W70-02597 05D

CALIFORNIA UNIV., DAVIS. DEPT. OF POLITICAL SCIENCES. A COMPREHENSIVE STUDY OF THE USE TAX AS A MEANS OF ALLOCATION OF WATER RESOURCES IN A CONJUNCTIVE USE SYSTEM, W70-02757 06C

CALIFORNIA UNIV., LOS ANGELES. DEPT. OF ECONOMICS. ALLOCATIVE IMPACTS OF FEDERAL AND STATE WATER DEVELOPMENT

LAW, W70-02736	06E	STABILIZATION OF AN ACTIVATED SLUDGE PLANT, W70-02593	05D
CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOILS AND PLANT NUTRITION.		COPENHAGEN UNIV. (DENMARK). GEOGRAPHICAL LAB. LAKE TYPES AND LAKE SEDIMENTS, W70-02683	02B
EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS. VI. EFFECTS OF THE EXTERNAL OSMOTIC WATER POTENTIAL ON SOLUTE REQUIREMENT, SALT TRANSPORT KINETICS AND GROWTH RATES OF LEAVES, W70-02566	02I	CORNELL UNIV., ITHACA, N.Y. NUTRIENT LIMITATION OF SUMMER PHYTOPLANKTON GROWTH IN CAYUGA LAKE, W70-02443	05C
CARLETON UNIV., OTTAWA (ONTARIO). DEPT. OF BIOLOGY. INFLUENCE OF STARVATION ON SELECTED TEMPERATURE OF SOME SALMONIDS, W70-02706	05C	CORNELL, HOWLAND, HAYES AND MERRIFIELD, SEATTLE, WASH. MONTANA STATE UNIV., BOZEMAN. DEPT. OF CIVIL ENGINEERING AND MONTANA STATE UNIV., BOZEMAN. DEPT. OF ENGINEERING MECHANICS.	02B
CARNEGIE INST. OF TECH., PITTSBURGH, PA. AND MASSACHUSETTS INST. OF TECH., CAMBRIDGE. NEW TABLES FOR OXYGEN SATURATION OF SEAWATER, W70-02704	01B	EFFECTS OF UNIT WEIGHT AND SLOPE ON EROSION, W70-02451	02J
CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT, WEST PALM BEACH, FLA. SALT-WATER INTRUSION IN SOUTHEASTERN FLORIDA, W70-02486	02L	CORPS OF ENGINEERS, BUFFALO, N.Y. FLOOD PLAIN INFORMATION OF SCUAQUADA CREEK, IN THE TOWNS OF CHEEKATOGA AND LANCASTER, ERIE COUNTY, NEW YORK. W70-02629	04A
CENTRAL ARID ZONE RESEARCH INST., JODHPUR (INDIA). STUDIES IN THE TECHNIQUES OF FIELD TRIALS IN RANGE LANDS I. SIZE, SHAPE AND ARRANGEMENT OF PLOTS, W70-02551	03F	FLOOD PLAIN INFORMATION OF CANANDAIGUA OUTLET IN THE COUNTIES OF ONTARIO AND WAYNE, NEW YORK. W70-02667	04A
GERMINATION STUDIES OF PERENNIAL GRASS SEEDS, W70-02552	02I	CORPS OF ENGINEERS, NEW YORK. NORTH ATLANTIC DIV. WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN NEW YORK. W70-02645	04A
PHYTOSOCIOLOGICAL VARIATIONS IN FLORISTIC COMPOSITION OF THE VEGETATION IN THE ARID ZONE I. MONSOONAL VEGETATION OF THE ALLUVIAL PLAINS, W70-02553	02I	CORPS OF ENGINEERS, PHILADELPHIA, PA. NORTH ATLANTIC DIV. WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN PENNSYLVANIA. W70-02644	04A
STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GROWTH AND FORAGE PRODUCTION OF DHAMAN (CENCHRUS CILIARIS) AND SEWAN (CLASIOTUS SINDICUS) PASTURES IN THE ESTABLISHMENT YEAR, W70-02554	03F	DADE COUNTY ENGINEERING DEPT., MIAMI, FLA. COMBATING SALT-WATER ENCROACHMENT INTO THE BISCAYNE AQUIFER OF MIAMI, FLORIDA. W70-02485	02L
CHEMUNG COUNTY SEWER DISTRICT, ELMIRA, N.Y. DOSES PROTECT TRICKLING FILTERS, W70-02615	05D	DAMES AND MOORE, NEW YORK. REABRATION MEASUREMENTS IN AN ESTUARY, W70-02636	05G
CLEMSON, UNIV., S.C. INTERACTION OF PESTICIDE POLLUTANTS AND AQUATIC FOOD-CHAIN ORGANISMS, W70-02677	05C	DEFENCE RESEARCH ESTABLISHMENT OTTAWA, ONTARIO AND SMITHSONIAN INSTITUTION, WASHINGTON, D.C. RADIATION BIOLOGY LAB.	02B
COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING. LOCAL SCOUR AROUND BRIDGE PIERS, W70-02462	08B	DENSITY STRATIFIED LAKES IN NORTHERN ELLESmere ISLAND, W70-02446	02H
SUITABILITY OF THE UPPER COLORADO RIVER BASIN FOR PRECIPITATION MANAGEMENT, W70-02622	03B	DELaware RIVER BASIN COMMISSION, TRENTON, N.J. DELaware RIVER BASIN COMMISSION ANNUAL REPORT 1969. W70-02694	05G
COLUMBIA UNIV., DOBBS FERRY, N.Y. HUDSON LABS. A FALLING-PARTICLE CURRENT METER, W70-02670	07B	DELaware UNIV., NEWARK. DEPT. OF CIVIL ENGINEERING. EFFECT OF BORON ON BIOLOGICAL WASTE TREATMENT, W70-02734	05D
COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, RIVERINA (AUSTRALIA). RIVERINA LAB. THE EFFECT OF GYPSUM ON THE WATER STORAGE IN A SANDY LOAM SOIL UNDER AN IRRIGATED PERENNIAL PASTURE, W70-02557	02G	DEPARTMENT OF PUBLIC WORKS (CANADA). SHORE EROSION AND PROTECTION ST. LAWRENCE RIVER-CANADA, W70-02697	08A
COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, GRIFFITH (AUSTRALIA). IRRIGATION RESEARCH LAB. IRRIGATION IN ARID LANDS, W70-02559	03F	DOW CHEMICAL COMPANY, FREEPORT, TEX. SEA WATER CORROSION TEST PROGRAM, W70-02691	08G
DETERMINATIONS OF LEAF AND FRUIT WATER POTENTIAL WITH A PRESSURE CHAMBER, W70-02568	02I	DOW CHEMICAL CO., FREEPORT, TEX. TEXAS DIV. SALT WATER CORROSION CONTROL BY ENVIRONMENT MODIFICATION, W70-02689	08G
CONNECTICUT UNIV., STORRS. EROSION PREVENTION EXPERIMENTS, W70-02730	04D	DUKE POWER CO., CHARLOTTE, N.C. COOLING WATER STUDIES AT ELECTRIC POWER STATION, W70-02713	05B
EFFECTS OF SIMULTANEOUS VARIATION OF TEMPERATURE AND DISSOLVED OXYGEN ON THE RESISTANCE OF FISHES TO CONTROLLED POLLUTANTS, W70-02731	05C	DUKE UNIV., BEAUFORT, N.C. MARINE LAB. PARTICULATE ALUMINUM AND IRON IN SEA WATER OFF THE SOUTHEASTERN COAST OF THE UNITED STATES, W70-02630	02K
STUDIES ON PHOSPHOROUS TRANSFORMATIONS IN EUTROPHIC LAKES, W70-02747	05C	EBASCO SERVICES, INC. PLANNING FOR POWER - A LOOK AT TOMORROW'S STATION SIZES, W70-02740	08C
RELATION OF BEDROCK FRACTURE SYSTEMS TO UNDERGROUND WATER SUPPLIES IN THE STAFFORD SPRINGS, SOUTH CONVENTRY, SPRING FIELD, AND WESTFORD QUADRANGLES, W70-02756	02P	ENGINEERING LABS., CAMBRIDGE (ENGLAND). AIR ENTRAIMENT BY FLOWING WATER UNDER REDUCED ATMOSPHERIC PRESSURE, W70-02674	02E
CONNECTICUT UNIV., STORRS. INST. OF WATER RESOURCES. RATE AND DIRECTION OF GROUNDWATER CIRCULATION IN CLOSE SPACED BEDROCK AND GRAVEL WELLS UNDER NON-SYNCHRONOUS PUMPING TIME AND RATES, W70-02735	04B	FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, ADA, OKLA. PHOSPHATE REMOVAL AT FORT WORTH, TEXAS, W70-02596	05D
THE DETERMINATION OF THE ENGINEERING THERMO-PHYSICAL PROPERTIES OF SOLUTIONS CONTAINING DISSOLVED SOLIDS, W70-02749	02K	FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, ALAMEDA, CALIF. ALGAL GROWTH ASSESSMENTS BY FLUORESCENCE TECHNIQUES, W70-02777	05A
CONSOR, TOWNSEND AND ASSOCIATES, CHICAGO, ILL.		FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, CINCINNATI, OHIO. PRELIMINARY DESIGN OF WASTEWATER TREATMENT SYSTEMS, W70-02610	05D
		FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, DALLAS, TEX. AND CORPS OF ENGINEERS, TULSA, OKLA. ENGINEERING DIV. MEASURING SUBSURFACE SPRING FLOW WITH RADIOTRACERS, W70-02637	07B
		FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WASHINGTON,	

ORGANIZATIONAL INDEX

FED-10W

D.C. OFFICE OF PUBLIC INFORMATION. A PRIMER ON WASTE WATER TREATMENT. W70-02638	05D	W70-02661 HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NW QUADRANGLE, MISSISSIPPI, W70-02662	07C 07C
FOREST SERVICE (USDA), ALBUQUERQUE, N. MEX. ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION. ALKALI SACATON SEEDLINGS GERMINATION AND SURVIVAL IN AN AGAR AND SOIL MEDIUM, W70-02685	06A	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASS CHRISTIAN QUADRANGLE, MISSISSIPPI, W70-02663	07C
FOREST SERVICE (USDA), JUNEAU, ALASKA. PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION. SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS, W70-02724	04C	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NORTH-SOUTH QUADRANGLES, MISSISSIPPI, W70-02664	07C
FOREST SERVICE, (USDA), BERKELEY, CALIF. PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION. WATER REPELLENT SOILS A WORLDWIDE CONCERN IN MANAGEMENT OF SOIL AND VEGETATION, W70-02686	04A	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, VIDALIA QUADRANGLE, MISSISSIPPI, W70-02665	07C
FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE(ENGLAND). THE IMPORTANCE OF PROTOZOA IN CONTROLLING THE ABUNDANCE OF PLANKTONIC ALGAE IN LAKES, W70-02500	02H	HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, WAVELAND-GRAND ISLAND PASS QUADRANGLES, MISSISSIPPI, W70-02666	07C
GANNETT, FLEMING, CORDDRY, AND CARPENTER, INC., HARRISBURG, PA. ENGINEERING ASPECTS OF WASTEWATER CONTRACTS, W70-02605	05D	GEOLOGICAL SURVEY, WASHINGTON, D.C. WATER RESOURCES DIV. THE EFFECT OF THE ADDITION OF HEAT FROM A POWERPLANT ON THE THERMAL STRUCTURE AND EVAPORATION OF LAKE COLCRAD CITY, TEXAS, W70-02703	02D
GENERAL ACCOUNTING OFFICE, WASHINGTON, D.C. EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING, AND PREVENTING POLLUTION, B-166506, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION. W70-02743	05G	GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF CIVIL ENGINEERING. A STUDY OF FLOW CONDITIONS IN SHAFT SPILLWAYS, W70-02774	08A
GEOLOGICAL SURVEY OF AFGHANISTAN, KABUL. WATER RESOURCES DIV. HYDROGRAPHIC AND SEDIMENTATION SURVEY OF KAJAKAI RESERVOIR, AFGHANISTAN, W70-02669	02J	GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF ENGINEERING, AND HARZA ENGINEERING CO., CHICAGO, ILL. DEPT. OF HYDRAULICS. OPEN-CHANNEL SURGE SIMULATION BY DIGITAL COMPUTER, W70-02459	08B
GEOLOGICAL SURVEY, BISMARCK, N. DAK. GEOLOGY AND GROUNDWATER RESOURCES OF CASS COUNTY, NORTH DAKOTA PART 3, W70-02675	02F	GEORGIA UNIV., ATHENS. BIOLOGICAL SCIENCES DIV. PHOSPHORUS BUDGETS OF LAKES SIDNEY LANIER AND HARTWELL, GEORGIA, W70-02752	05G
GEOLOGICAL SURVEY, DENVER, COLO. LATERAL MIGRATIONS OF THE ARKANSAS RIVER DURING THE QUATERNARY-FOWLER, COLORADO, TO THE COLORADO-KANSAS STATE LINE, W70-02475	02J	GEORGIA UNIV., SAPELO ISLAND. MARINE INST. MEASURING ORGANIC MATTER RETAINED BY AQUATIC INVERTEBRATES, W70-02790	05C
GEOLOGICAL SURVEY, HONOLULU, HAWAII. AN INVESTIGATION OF FLOODS IN HAWAII THROUGH SEPTEMBER 30, 1968, W70-02471	07C	PHOSPHORUS EXCRETION AND BODY SIZE IN MARINE ANIMALS MICROZOOPLANKTON AND NUTRIENT REGENERATION, W70-02791	05C
GEOLOGICAL SURVEY, JACKSON, MISS. FLOODS IN MISSISSIPPI-SEPTEMBER 1965 THROUGH SEPTEMBER 1967, W70-02621	02E	GRUNER BROTHERS, BASLE (SWITZERLAND). VIGILANCE OVER RESERVOIRS, W70-02639	06E
GEOLOGICAL SURVEY, JACKSON, MISS. WATER RESOURCES DIV. FLOODS OF JUNE 1, 1967 IN SOUTHWESTERN JACKSON, MISSISSIPPI, W70-02477	02E	GULBENKIAN INST. OF SCIENCE, OEIRAS (PORTUGAL). IAP. CF MICROBIOLOGY. KINETICS OF NUTRIENT-LIMITED GROWTH, W70-02763	05C
WATER FOR INDUSTRIAL DEVELOPMENT IN COVINGTON, JEFFERSON DAVIS, LAMAR, LAWRENCE, MARION, AND WALTHALL COUNTIES, MISSISSIPPI, W70-02478	03E	HARVARD UNIV., CAMBRIDGE, MASS. BIOLOGICAL LABS. THE MECHANISM OF PHOTOSYNTHESIS, W70-02503	02K
BIG BLACK RIVER, MISSISSIPPI COMPREHENSIVE BASIN STUDY - ANNEX F. GEOLOGY AND WATER RESOURCES, W70-02672	02E	HARVARD UNIV., CAMBRIDGE, MASS. DEPT. OF GEOLOGICAL SCIENCES. THERMODYNAMIC MIXING PROPERTIES OF NaCl LIQUIDS, W70-02627	02K
GEOLOGICAL SURVEY, MIAMI, FLA. WATER RESOURCES DIV. SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK, W70-02631	04C	HARVARD UNIV., CAMBRIDGE, MASS. SANITARY ENGINEERING DIV. SOLUBILITY OF ATMOSPHERIC OXYGEN IN WATER, W70-02702	02K
GEOLOGICAL SURVEY, SPOKANE, WASH. GLACIAL DRAINAGE DIVIDE IN THE SKAGIT VALLEY, WASHINGTON, W70-02458	02C	ILLINOIS STATE WATER SURVEY, URBANA. URBAN RUNOFF BY ROAD RESEARCH LABORATORY METHOD, W70-02467	04C
GEOLOGICAL SURVEY, WASHINGTON, D.C. FLOODS IN TRIPLETT CREEK IN VICINITY OF MOREHEAD, KENTUCKY, W70-02496	02E	ILLINOIS STATE WATER SURVEY, URBANA. HYDROLOGY SECTION. THEORETICAL BASEFLOW CURVES, W70-02460	02A
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, LOGTOWN QUADRANGLE, MISSISSIPPI, W70-02497	02E	ILLINOIS UNIV., URBANA. DEPT. OF CIVIL ENGINEERING. VIRUS REMOVAL BY CHEMICAL COAGULATION, W70-02767	05F
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, ENGLISH LOOKOUT QUADRANGLE, LOUISIANA-MISSISSIPPI, W70-02498	02E	INSTITUT D'AMENAGEMENT ET D'ECONOMIE DE L'EAU, WARSAW (POLAND). REVETMENTS FOR BANK PROTECTION USING VERY ROUGH-SUFBACED FERRO-CONCRETE ELEMENTS (FRENCH), W70-02696	08A
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KILO QUADRANGLE, MISSISSIPPI, W70-02499	02E	INSTITUTE FOR LAND AND WATER MANAGEMENT RESEARCH, WAGENINGEN(NETHERLANDS). A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967, W70-02495	06B
WATER IN THE KAHUKU AREA, OAHU, HAWAII, W70-02623	03B	INSTITUTE OF EXPERIMENTAL METEOROLOGY (USSR). RESULTS OF ATMOSPHERIC CIRCULATION STUDIES OVER EUROPE, ASIA, AND THE ARCTIC BY RADAR-METEON TECHNIQUE (RUSSIAN), W70-02655	02B
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUADRANGLES, MISSISSIPPI-ALABAMA, W70-02660	07C	INSTITUTO MEXICANO DEL PETROLEO, MEXICO. SIMULTANEOUS DETERMINATION OF BASIC GEOMETRICAL CHARACTERISTICS OF POROUS MEDIA, W70-02466	08G
HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BAY ST. LOUIS QUADRANGLE, MISSISSIPPI, W70-02659	02E	IOWA STATE UNIV., AMES. DEPT. OF AGRONOMY. GROUND WATER SEEPAGE PATTERNS TO WELLS FOR UNCONFINED FLOW, W70-02759	02G
		IOWA STATE WATER RESOURCES RESEARCH INST., AMES.	

ORGANIZATIONAL INDEX

DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE SIMULATION OF FLATLAND WATERSHED HYDRAULICS, W70-02676	02G	MICROBIOLOGY. THE EFFECT OF ELEVATED TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE, W70-02710	05D
JOHNS HOPKINS UNIV., BALTIMORE, MD. DEPT. OF OCEANOGRAPHY. NEW MEASUREMENTS OF OXYGEN SOLUBILITY IN PURE AND NATURAL WATER, W70-02712	02K	MISSOURI UNIV., COLUMBIA. DEPT. OF CHEMISTRY. A FLUOROMETRIC METHOD FOR DETERMINING TRACE QUANTITIES OF FLUORIDE, W70-02726	07B
KENTUCKY UNIV., LEXINGTON. ANALOG SIMULATION OF ACTIVATED SLUDGE SYSTEMS, W70-02608	05D	A FLUOROMETRIC DETERMINATION OF IODIDE ION, W70-02727	07B
ENERGY CONCEPTS OF AEROBIC MICROBIAL METABOLISM, W70-02613	05D	FLUOROMETRIC DETERMINATION OF OXALATE ION, W70-02728	07B
KENTUCKY WATER RESOURCES INST., LEXINGTON. CHEMISTRY OF THE OXIDANT, FERRATE, ITS INTERACTION WITH SPECIFIC ORGANICS FOUND IN WASTE WATER, W70-02738	05G	MISSOURI UNIV., ROLLA. DEPT. OF CIVIL ENGINEERING AND COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING. NONLINEAR FLOW IN POROUS MEDIA, W70-02464	02F
LITTLE (ARTHUR D.), INC., CAMBRIDGE, MASS. COMBATING POLLUTION CREATED BY OIL SPILLS, VOLUME I METHODS, W70-02744	05G	MIXING EQUIPMENT CO., ROCHESTER, N.Y. EXPERIMENTAL PROBLEMS ASSOCIATED WITH THE TESTING OF SURFACE AERATION EQUIPMENT, W70-02612	05D
LONDON UNIV. (ENGLAND). INST. OF EDUCATION. DESERTS - THE PROBLEM OF WATER IN ARID LANDS, W70-02561	02A	NATIONAL CENTER FOR ATMOSPHERIC RESEARCH, BOULDER, COLO. ATMOSPHERIC SCIENCE LAB. LEAD AND OTHER METAL IONS IN UNITED STATES PRECIPITATION, W70-02644	05B
LONG ISLAND UNIV., GREENVALE, N.Y. C. W. POST COLL. THE MAJARDAB SCHEME, W70-02560	03F	NATIONAL INST. FOR WATER RESEARCH, PRETORIA (SOUTH AFRICA). FACTOR ANALYSIS AS AN AID IN AN ECOLOGICAL STUDY OF ANAEROBIC DIGESTION, W70-02594	05D
LOS ANGELES COUNTY FLOOD CONTROL DISTRICT, CALIF. THE AMELIORATION OR PREVENTION OF SALT-WATER INTRUSION IN AQUIFERS - EXPERIENCE IN LOS ANGELES COUNTY, CALIFORNIA, W70-02491	02L	THE EFFECT OF METHANE ANALOGUES ON METHANOGENESIS IN ANAEROBIC DIGESTION, W70-02595	05D
LOS ANGELES COUNTY FLOOD CONTROL DISTRICT, CALIF.. WATER CONSERVATION DIV. THE HYDROGEOLOGIC SETTING IN LOS ANGELES COUNTY, CALIFORNIA, W70-02490	02L	THE PROTEOLYTIC BACTERIA PRESENT IN THE ANAEROBIC DIGESTION OF RAW SEWAGE SLUDGE, W70-02602	05D
LOUISIANA WATER RESOURCES RESEARCH INST., BATON ROUGE. PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA, W70-02766	05C	ANAEROBIC DIGESTION I. THE MICROBIOLOGY OF ANAEROBIC DIGESTION (REVIEW PAPER), W70-02603	05D
MALAWI UNIV., LIMBE. LIMITATION OF ALGAL GROWTH IN SOME CENTRAL AFRICAN WATERS, W70-02646	05C	NATURE CONSERVANCY, EDINBURGH (SCOTLAND) FRESHWATER BIOLOGICAL ASSOCIATION, ASBLESIDE, (ENGLAND). FRESHWATER PRIMARY PRODUCTION BY A BLUE-GREEN ALGA OF BACTERIAL SIZE, W70-02508	02B
MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF SANITARY CHEMISTRY. FERTILIZATION OF LAKES BY AGRICULTURAL AND URBAN DRAINAGE, W70-02787	05B	NAVAL SHIP ENGINEERING CENTER, PORT HUENEME, CALIF. PCBT HUEENE DIV. STALACTITE GROWTH BENEATH SEA ICE, W70-02620	02C
MASSACHUSETTS INST. OF TECH., CAMBRIDGE. HYDRODYNAMICS LAB. LAB. AND IOWA UNIV., IOWA CITY. INST. OF HYDRAULIC RESEARCH. FRICTION FACTORS FOR FLOW IN SAND-BED CHANNELS, W70-02461	02J	NEBRASKA UNIV., LINCOLN. DEPT. OF ECONOMICS. THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA, W70-02479	03F
MASSACHUSETTS INST. OF TECH., CAMBRIDGE. HYDRODYNAMICS LAB. THE TRANSFORMATION OF A SOLITARY WAVE OVER AN UNEVEN BOTTOM, W70-02625	02L	NEVADA AGRICULTURAL EXPERIMENT STATION, RENO AND AGRICULTURAL RESEARCH SERVICE, AMES, IOWA. SOIL AND WATER CONSERVATION RESEARCH DIV. WATER REQUIREMENTS OF LAWNGRASS, W70-02562	02D
MASSACHUSETTS UNIV., AMHERST. WATER RESOURCES RESEARCH CENTER. THE ECOLOGY OF THE YOUNG FISHES OF THE NEWANTIC RIVER ESTUARY, W70-02678	05C	NEVADA UNIVERSITY, RENO. CENTER FOR WATER RESOURCES RESEARCH. LOCAL MOISTURE AND PRECIPITATION, W70-02668	02B
MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF BOTANY AND PLANT PATHOLOGY. OBJECTIONABLE ALGAE WITH REFERENCE TO THE KILLING OF FISH AND OTHER ANIMALS, W70-02803	05C	NEW HAMPSHIRE UNIV., DURHAM. DEPT. OF BOTANY. PHYTOPLANKTON FLORA OF NEWFOUND AND WINNISQUA LAKES, NEW HAMPSHIRE, W70-02764	05C
MICHIGAN UNIV., ANN ARBOR. DEPT. OF ZOOLOGY. INTERRELATIONS OF DISSOLVED ORGANIC MATTER AND PHYTOPLANKTON, W70-02510	05C	NEW HAMPSHIRE POPULATIONS IN RELATION TO TROPHIC LEVELS OF LAKES IN NEW HAMPSHIRE, U.S.A. W70-02772	05C
MIDWEST RESEARCH INST., KANSAS CITY, MO. ULTRASONIC DETECTION OF CALCIUM SULFATE SCALE ON METAL SURFACES, W70-02690	08G	NEW MEXICO STATE UNIV., UNIVERSITY PARK. SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL, W70-02729	02G
MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CIVIL ENGINEERING AND IOWA STATE UNIV., AMES. DEPT. OF ENGINEERING MECHANICS. FLUCTUATING PRESSURES IN SPILLWAY STILLING BASINS, W70-02457	08B	NEW SOUTH WALES UNIV., SYDNEY (AUSTRALIA). DEPT. OF CIVIL ENGINEERING AND IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND). DATA ERROR EFFECTS IN UNIT HYDROGRAPH DERIVATION, W70-02454	07A
MINNESOTA UNIV., MINNEAPOLIS. LIMNOLOGICAL RESEARCH CENTER. EFFECT OF YELLOW ORGANIC ACIDS ON IRON AND OTHER METALS IN WATER, W70-02505	02K	NEW YORK STATE DEPT. OF CONSERVATION, ALBANY. DIV. OF WATER RESOURCES. PROTECTING LONG ISLAND AQUIFERS AGAINST SALT-WATER INTRUSION, W70-02488	02L
CLADOCERAN FAUNAS ASSOCIATED WITH AQUATIC MACROPHYTES IN SOME LAKES IN NORTHWESTERN MINNESOTA, W70-02789	02H	NEW YORK UNIV., N.Y. INST. OF ENVIRONMENTAL MEDICINE AND ENVIRONMENTAL PROTECTION ADMINISTRATION OF NEW YORK CITY. WATER QUALITY IN INDUSTRIAL AREAS PROFILE OF A RIVER, W70-02493	05C
MISSISSIPPI STATE UNIV., STATE COLLEGE AND INTERNATIONAL PAPER CO., MOBILE, ALA. SOUTHERN KRAFT DIV. TREATMENT OF KRAFT MILL WASTES WITH A PLASTIC MEDIA TRICKLING FILTER, W70-02606	05D	NORGES TEKNISKE HOEGSKOLE, TRONDHEIM. RIVER AND HARBOUR LAB. MOVEMENT OF SAND IN TUNNELS, W70-02465	06B
MISSISSIPPI STATE UNIV., STATE COLLEGE. DEPT. OF		NORTH CAROLINA STATE UNIV., RALEIGH. DEPT. OF CHEMISTRY.	

INFLUENCE OF PH ON THE ADSORPTION OF AROMATIC ACIDS ON ACTIVATED CARBON. W70-02443	05G	
NORTH CAROLINA STATE UNIV., RALEIGH. DEPT. OF ZOOLOGY. RESPIRATION CORRECTIONS FOR BACTERIAL UPTAKE OF DISSOLVED ORGANIC COMPOUNDS IN NATURAL WATERS. W70-02641	05A	
NORTH CAROLINA UNIV., CHAPEL HILL. THE USE OF STREAM CHANNELS TO DELIVER STORED WATER THE POSSIBILITY OF INTERFERENCE BY THIRD PARTIES. W70-02765	06E	
NORTH CAROLINA UNIV., MOREHEAD CITY. INST OF MARINE SCIENCES. CURRENT STUDY IN THE NEUSE RIVER AND ESTUARY OF NORTH CAROLINA. W70-02760	02L	
NORTH LITTLE ROCK SEWER DEPT., ARK. SLUDGE DISPOSAL EXPERIENCES AT NORTH LITTLE ROCK, ARKANSAS. W70-02616	05D	
NORTH TEXAS STATE UNIV., DENTON. DEPT. OF BIOLOGY. MEMBRANE FILTER-FLUORESCENT-ANTIBODY METHOD FOR DETECTION AND ENUMERATION OF BACTERIA IN WATER. W70-02782	05A	
NOVA SCOTIA TECHNICAL COLL., HALIFAX. DESIGN PRINCIPLES OF WASTE STABILIZATION PONDS. W70-02609	05D	
OAK RIDGE NATIONAL LAB., TENN. RADIATION ECOLOGY SECTION. INTERPRETATION OF RADIONUCLIDE UPTAKE FROM AQUATIC ENVIRONMENTS. W70-02786	05A	
ONTARIO WATER RESOURCES COMMISSION, TORONTO. DIV. OF RESEARCH. EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES, W70-02792	05C	
NUTRIENT-PHYTOPLANKTON RELATIONSHIPS IN EIGHT SOUTHERN ONTARIO LAKES. W70-02795	05C	
ORANGE COUNTY WATER DISTRICT, SANTA ANA, CALIF. PLANNING AND PROVIDING AN ADEQUATE SUPPLY OF WATER FOR ORANGE COUNTY, CALIFORNIA. W70-02487	02L	
THE CHALLENGE OF WATER MANAGEMENT ORANGE COUNTY WATER DISTRICT, CALIFORNIA. W70-02489	02L	
OREGON STATE UNIV., CORVALLIS. DEPT. OF BOTANY. STRUCTURAL CHARACTERISTICS OF BENTHIC ALgal COMMUNITIES IN LABORATORY STREAMS. W70-02780	05C	
SOME FACTORS AFFECTING RESPIRATION OF PERIPHYTON COMMUNITIES IN LOTIC ENVIRONMENTS. W70-02781	05C	
SOME EFFECTS OF CURRENT VELOCITY ON PERIPHYTON COMMUNITIES IN LABORATORY STREAMS. W70-02794	05C	
OREGON STATE UNIV., CORVALLIS. DEPT. OF OCEANOGRAPHY FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WASHINGTON, D.C. DIV. OF ENGINEERING DEVELOPMENT AND IDAHO UNIV., MOSCOW. DEPT. OF CHEMISTRY. ALKALINITY BUDGET OF THE COLUMBIA RIVER. W70-02642	02K	
PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. COLL. OF ENGINEERING. BEDLOAD FORMULAS. W70-02671	02J	
PHILADELPHIA ELECTRIC CO., PA. DEPT. OF ENGINEERING AND RESEARCH AND CORNELL UNIV., ITHACA, N.Y. DEPT. OF ZOOLOGY. THERMAL DISCHARGES FROM LARGE NUCLEAR PLANT. W70-02635	05B	
PRINCETON UNIV., N.J. DEPT. OF GEOLOGY AND SHELL OIL CO., HOUSTON, TEX. TECHNICAL SERVICES DIV. MODERN HYDROCARBONS IN TWO WISCONSIN LAKES. W70-02509	02H	
PRINCETON UNIV., N.J. DEPT. OF CHEMISTRY. PROTON MAGNETIC RESONANCE SPECTRUM OF POLYWATER. W70-02617	01A	
PURDUE UNIV., LAFAYETTE, IND. SCHOOL OF CIVIL ENGINEERING. FORTRAN-HYDRO. W70-02453	07C	
RESEARCH COUNCIL OF ALBERTA, EDMONTON AND GEOLOGICAL SURVEY, DENVER, COLO. GEOCHEMISTRY AND ORIGIN OF FORMATION WATERS IN THE WESTERN CANADA SEDIMENTARY BASIN - 1. STABLE ISOTOPES OF HYDROGEN AND OXYGEN. W70-02628	02K	
RESOURCES FOR THE FUTURE, INC., WASHINGTON, D.C. INLAND WATERWAY TRANSPORTATION, STUDIES IN PUBLIC AND PRIVATE MANAGEMENT AND INVESTMENT DECISIONS. W70-02700	06B	
RHODE ISLAND UNIV., KINGSTON. BUOYANCY AND SINKING CHARACTERISTICS OF FRESHWATER PHYTOPLANKTON. W70-02754	05G	
RHODE ISLAND UNIV., KINGSTON. DEPT. OF AGRICULTURAL CHEMISTRY. AN INVESTIGATION OF THE STRUCTURAL CHEMISTRY OF YELLOW ORGANIC MATTER IN FRESH WATER. W70-02769	02K	
RHODE ISLAND UNIV., KINGSTON. DEPT. OF BIOPHYSICS. BIODEGRADATION OF WATER POLLUTANTS WITH CULTURED MAMMALIAN CELLS. W70-02771	05A	
RHODE ISLAND UNIV., KINGSTON. DEPT. OF CIVIL ENGINEERING AND RHODE ISLAND UNIV., KINGSTON. DEPT. OF OCEAN ENGINEERING. DYNAMIC BEHAVIOR OF SOIL, W70-02751	08E	
RHODE ISLAND UNIV., KINGSTON. DEPT. OF CIVIL ENGINEERING. INVESTIGATION OF SOIL FREEZING. W70-02750	08E	
RHODE ISLAND UNIV., KINGSTON. DEPT. OF MECHANICAL ENGINEERING AND APPLIED MECHANICS. IRON AND MANGANESE REMOVAL FROM SMALL GROUNDWATER SUPPLIES. W70-02755	05F	
RHODE ISLAND UNIV., KINGSTON. DEPT. OF PHARMACY. CORRELATION OF STRUCTURE VS ACTIVITY OF POLLUTANTS OF FRESH WATER, W70-02753	05C	
RHODE ISLAND UNIV., KINGSTON. WATER RESOURCES CENTER. ANALYSIS OF TRACE ELEMENTS IN WATER. W70-02768	05A	
ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO. ENGINEERING SECTION. IMPOUNDMENT INFLUENCES ON WATER QUALITY. W70-02785	05G	
ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO. LAB. OF PHYSICAL AND ENGINEERING SCIENCES. SIMULTANEOUS DETERMINATION OF ZN-65-30 AND P-32-15 IN SHELLFISH BY RADIOCHEMICAL TECHNIQUES, W70-02796	05A	
RUTGERS - THE STATE UNIV., NEW BRUNSWICK, N.J. DEPT. OF ENVIRONMENTAL SCIENCES. ENUMERATION OF AUTOTROPHIC AMMONIUM-OXIDIZING BACTERIA IN MARINE WATERS BY A DIRECT METHOD. W70-02507	07B	
SASKATCHEWAN UNIV., SASKATOON. THE SUCCESSION OF 'BLOOM' SPECIES OF BLUE-GREEN ALGAE AND SOME CAUSAL FACTORS. W70-02684	02H	
SOME PHYSICAL AND CHEMICAL FACTORS IN THE METABOLISM OF LAKES, W70-02798	02H	
SASKATCHEWAN UNIV., SASKATOON. DEPT. OF BIOLOGY. A LIMNOLOGICAL COMPARISON OF TWELVE LARGE LAKES IN SASKATCHEWAN, W70-02511	02H	
SASKATCHEWAN UNIV., SASKATOON. DEPT. OF CIVIL ENGINEERING AND COLORADO STATE UNIV., PORT COLLINS. TRIANGULAR BROAD-CRESTED WEIR, W70-02449	07B	
SHELL DEVELOPMENT CO., HOUSTON, TEX. AND PURDUE UNIV., LAFAYETTE, IND. AN INVESTIGATION OF THE FLOW REGIME FOR HELE-SHAW FLOW. W70-02470	08B	
SOLAR, SAN DIEGO, CALIF. EVALUATION OF TITANIUM-PLATED STEEL IN A CHLORIDE ENVIRONMENT, W70-02741	08G	
SOUTH DAKOTA UNIV., VERMILLION. EFFECTS OF CHLORINATED HYDROCARBON INSECTICIDES ON THE FRESHWATER SEED SHRIMP, W70-02679	05C	
SOUTHAMPTON UNIV. (ENGLAND). DEPT. OF OCEANOGRAPHY. LINEAR EROSIONAL FURROWS IN SOUTHAMPTON WATER, W70-02445	02J	
SUEZ CANAL AUTHORITY RESEARCH CENTER, ISMAILIA (EGYPT) AND INTERNATIONAL COMMISSION FOR IRRIGATION AND DRAINAGE. HISTORICAL, FIELD AND EXPERIMENTAL STUDIES OF THE SUEZ CANAL BANK PROTECTION, W70-02698	08A	
TECHNICAL UNIV. OF PRAGUE (CZECHOSLOVAKIA). HYDROBIOLOGICAL CONTROL OF THE TREATMENT OF WASTE WATERS IN ACCUMULATION PONDS (CZECH), W70-02793	05B	
TECHNION - ISRAEL INST. OF TECH., HAIFA. DEPT. OF AGRICULTURAL ENGINEERING. MULTIPLE USE OF MEDITERRANEAN RANGE LANDS NEW APPROACHES TO OLD PROBLEMS, W70-02567	03F	

ORGANIZATIONAL INDEX

TECHNISCHE HOOGESCHOOL TWENTE, ENSCHEDE (NETHERLANDS). GRAVITY WAVES OVER A NON-UNIFORM FLOW, W70-02626	02L	WASHINGTON STATE UNIV., PULLMAN. DETERMINATION OF FLOWS FOR UNGAGED STREAMS, W70-02748	02A
TENNESSEE VALLEY AUTHORITY, NORRIS. EFFECT OF INTAKE ELEVATION AND OPERATION ON WATER TEMPERATURE, W70-02456	08B	EVALUATION OF FACTORS AFFECTING STREAM SELF-PURIFICATION, W70-02758	05G
TEXAS UNIV., AUSTIN. ENVIRONMENTAL HEALTH ENGINEERING RESEARCH LAB. NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- III. NITRIFICATION IN TRICKLING FILTERS, W70-02608	05D	ECOLOGY OF SELECTED AQUATIC BACTERIA IN THE SNAKE RIVER, W70-02762	05C
NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES-- III. DENITRIFICATION IN THE MODIFIED ACTIVATED SLUDGE PROCESS, W70-02607	05D	WATER PLANNING FOR ISRAEL LTD., TEL-AVIV. FACTORS DETERMINING THE HYDRAULIC CONDUCTIVITY OF FED MEDITERRANEAN SOILS AND DERIVED TYPES, W70-02558	02G
TEXAS WATER RIGHTS COMMISSION, BASIN HYDROLOGY SECTION AND UTAH STATE UNIV., LOGAN. DEPT. OF AGRICULTURAL AND IRRIGATION ENGINEERING. EXPRESSING IRRIGATION EFFICIENCY IN TERMS OF APPLICATION TIME, INTAKE AND WATER ADVANCE CONSTANTS, W70-02556	03F	WATER POLLUTION RESEARCH LAB., STEVENAGE (ENGLAND). DETERMINATION OF DISSOLVED OXYGEN BY THE WINKLER METHOD AND THE SOLUBILITY OF OXYGEN IN PURE WATER AND SEA WATER, W70-02705	02K
TOA HARBOUR WORKS CO. LTD., TOKYO (JAPAN). ENGINEERING DEPT. METHODS OF BANK PROTECTION FOR PORT, INLAND WATER-WAY AND RIVER, W70-02699	08A	WATERCOOKUNDIG LABORATORIUM, DELFT (NETHERLANDS). JETS WITH NEGATIVE BUOYANCY IN HOMOGENEOUS FLUID, W70-02715	02E
TOKYO IMPERIAL UNIV. (JAPAN). GEOGRAPHICAL INST. CONTRIBUTIONS TO THE KNOWLEDGE OF NITROGENOUS COMPOUNDS AND PHOSPHATE IN THE LAKE WATERS OF JAPAN, W70-02788	05C	WEST VIRGINIA UNIV., MORGANTOWN. WATER RESEARCH INST. ALGAE IN RELATION TO MINE WATER, W70-02770	05C
TOLEDO UNIV., OHIO. RITTER ASTROPHYSICAL CENTER. SUPERDENSE WATER ICE, W70-02619	02C	WESTERN ELECTRIC CO., INC., INDIANAPOLIS, IND. WESTERN ELECTRIC BUILDS MODERN PLANT FOR TREATING METAL FINISHING WASTES, W70-02601	05D
TOWNSVILLE UNIV. COLL. (AUSTRALIA). DEPT. OF CIVIL ENGINEERING. NONLINEAR FLOW IN POROUS MEDIA BY FINITE ELEMENTS, W70-02455	02P	WESTFIELD COLL., LONDON (ENGLAND). DEPT OF BOTANY AND UNIVERSITY COLL., LONDON. DEPT. OF BOTANY. EXTRACELLULAR PRODUCTS OF PHYTOPLANKTON PHOTOSYNTHESIS, W70-02504	05B
TRW SYSTEMS GROUP, REDONDO BEACH, CALIF. EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION, W70-02692	08G	WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA. DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER, W70-02693	08G
UNION CARBIDE CORP., SOUTH CHARLESTON, W. VA. COMPACT ACTIVATED-SLUDGE TREATMENT OF COMBINED PETROCHEMICAL MUNICIPAL WASTE, W70-02600	05D	W70-02742	08G
UNION COLL., SCHENECTADY, N.Y. WATER RESOURCES RESEARCH GROUP. STOCHASTIC BASIS FOR COMPREHENSIVE RIVER BASIN PLANNING PHASE I, W70-02681	06A	WILLIAMSON (JAMES) AND PARTNERS, GLASGOW (SCOTLAND). A HYDRAULIC MODEL STUDY OF HEAT DISSIPATION AT KINCARDINE POWER STATION, W70-02717	05B
UNITED STATES LAKE SURVEY, DETROIT, MICH. RIVER ICE JAMS - A LITERATURE REVIEW, W70-02494	02C	WISCONSIN UNIV., MADISON. REPORT ON THE NUTRIENT SOURCES OF LAKE MENDOTA, W70-02506	05B
UNIVERSIDAD DE LA REPUBLICA, MONTEVIDEO (URUGUAY). DEPT. OF FLUID MECHANICS. CONSIDERATIONS ON HYDRAULIC MODELS TO BE EMPLOYED TO STUDY RECIRCULATION INTAKE CONDITIONS OF COOLING WATER IN STEAM POWER STATIONS, W70-02707	05B	WISCONSIN UNIV., MADISON. WATER CHEMISTRY LAB. SEDIMENTARY PHOSPHORUS IN LAKE CORES--OBSERVATIONS ON DEPOSITIONAL PATTERN IN LAKE MENDOTA, W70-02800	02B
UNIVERSITY OF STRATHCLYDE, GLASGOW (SCOTLAND). DEPT. OF CIVIL ENGINEERING. SCALING PROCEDURES FOR MOBILE BED HYDRAULIC MODELS IN TERMS OF SIMILITUDE THEORY, W70-02473	02J	SEDIMENTARY PHOSPHORUS IN LAKE CORES--ANALYTICAL PROCEDURE, W70-02801	05A
VIRGINIA POLYTECHNIC INST., BLACKSBURG. A PRELIMINARY ECOLOGICAL SURVEY OF THE WATER RESOURCES AND LAND USE PATTERNS OF THE DISMAL SWAMP AREA OF VIRGINIA, W70-02786	06G	WOODS HOLE OCEANOGRAPHIC INSTITUTION, MASS. MINERAL NUTRITION OF PHYTOPLANKTON, W70-02804	05C
WORCESTER POLYTECHNIC INST., MASS. ALDEN HYDRAULIC LAB. USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES, W70-02709	05B	WYZSZA SZKOŁA ROlnicza, OLSZTYN-KORTOWA (POLAND). KATEDRA BOTANIKI. CLADOPHORA GLOMERATA AND CONCOMITANT ALGAE IN THE RIVER SKAWA. DISTRIBUTION AND CONDITIONS OF APPEARANCE, W70-02784	05C
YALE UNIV., NEW HAVEN, CONN. OSBORN ZOOLOGICAL LAB. THE OBLITERATION OF THE HYDROLYNNION, W70-02797	05C	YALE UNIV., NEW HAVEN, CONN. OSBORN ZOOLOGICAL LAB. THE OBLITERATION OF THE HYDROLYNNION, W70-02797	05C
ON THE RELATION BETWEEN THE OXYGEN DEFICIT AND THE PRODUCTIVITY AND TYPOLOGY OF LAKES, W70-02799	02H	YALE UNIV., NEW HAVEN, CONN. OSBORN ZOOLOGICAL LAB. THE OBLITERATION OF THE HYDROLYNNION, W70-02797	05C

ACCESSION NUMBER INDEX

05G	W70-02443	04A	W70-02525	05D	W70-02606	03A	W70-02687
05B	W70-02444	04A	W70-02526	05D	W70-02607	03A	W70-02688
02J	W70-02445	06E	W70-02527	05D	W70-02608	08G	W70-02689
02H	W70-02446	06E	W70-02528	05D	W70-02609	08G	W70-02690
02G	W70-02447	06E	W70-02529	05D	W70-02610	08G	W70-02691
02G	W70-02448	06E	W70-02530	05D	W70-02611	08G	W70-02692
07B	W70-02449	04A	W70-02531	05D	W70-02612	08G	W70-02693
02I	W70-02450	04D	W70-02532	05D	W70-02613	05G	W70-02694
02J	W70-02451	06E	W70-02533	05D	W70-02614	05G	W70-02695
02F	W70-02452	04A	W70-02534	05D	W70-02615	08A	W70-02696
07C	W70-02453	05G	W70-02535	05D	W70-02616	08A	W70-02697
07A	W70-02454	04A	W70-02536	01A	W70-02617	08A	W70-02698
02F	W70-02455	04A	W70-02537	01A	W70-02618	08A	W70-02699
08B	W70-02456	05G	W70-02538	02C	W70-02619	06B	W70-02700
08B	W70-02457	05G	W70-02539	02C	W70-02620	02K	W70-02701
02C	W70-02458	06B	W70-02540	02E	W70-02621	02K	W70-02702
08B	W70-02459	06B	W70-02541	03B	W70-02622	02D	W70-02703
02A	W70-02460	06E	W70-02542	03B	W70-02623	01B	W70-02704
02J	W70-02461	05G	W70-02543	08E	W70-02624	02K	W70-02705
08B	W70-02462	05G	W70-02544	02L	W70-02625	05C	W70-02706
08B	W70-02463	06E	W70-02545	02L	W70-02626	05B	W70-02707
02F	W70-02464	04A	W70-02546	02K	W70-02627	05B	W70-02709
08B	W70-02465	04A	W70-02547	02K	W70-02628	05D	W70-02710
08G	W70-02466	06E	W70-02548	04A	W70-02629	02K	W70-02712
04C	W70-02467	05G	W70-02549	02K	W70-02630	05B	W70-02713
05E	W70-02468	05F	W70-02550	04C	W70-02631	05D	W70-02714
08B	W70-02469	03F	W70-02551	03C	W70-02632	02E	W70-02715
08B	W70-02470	02I	W70-02552	07B	W70-02633	02H	W70-02716
07C	W70-02471	02I	W70-02553	02B	W70-02634	05B	W70-02717
02E	W70-02472	03F	W70-02554	05B	W70-02635	06E	W70-02718
02J	W70-02473	04D	W70-02555	05G	W70-02636	04C	W70-02724
02E	W70-02474	03F	W70-02556	07B	W70-02637	05G	W70-02725
02J	W70-02475	02G	W70-02557	05D	W70-02638	07B	W70-02726
02L	W70-02476	02G	W70-02558	06E	W70-02639	07B	W70-02727
02E	W70-02477	03F	W70-02559	05G	W70-02640	07B	W70-02728
03E	W70-02478	03F	W70-02560	05A	W70-02641	02G	W70-02729
03F	W70-02479	02A	W70-02561	02K	W70-02642	04D	W70-02730
08A	W70-02480	02D	W70-02562	05C	W70-02643	05C	W70-02731
02J	W70-02481	03F	W70-02563	04A	W70-02644	06E	W70-02732
02A	W70-02482	02H	W70-02564	04A	W70-02645	02D	W70-02733
02H	W70-02483	02G	W70-02565	05C	W70-02646	05D	W70-02734
02L	W70-02484	02I	W70-02566	02L	W70-02647	04B	W70-02735
02L	W70-02485	03F	W70-02567	03F	W70-02648	06E	W70-02736
02L	W70-02486	02I	W70-02568	02C	W70-02649	06E	W70-02737
02L	W70-02487	06E	W70-02569	02B	W70-02650	05G	W70-02738
02L	W70-02488	04A	W70-02570	02D	W70-02651	05B	W70-02739
02L	W70-02489	05G	W70-02571	02G	W70-02652	08C	W70-02740
02L	W70-02490	04A	W70-02572	02C	W70-02653	08G	W70-02741
02L	W70-02491	04A	W70-02573	02C	W70-02654	08G	W70-02742
02L	W70-02492	04A	W70-02574	02B	W70-02655	05G	W70-02743
05C	W70-02493	04A	W70-02575	02B	W70-02656	05G	W70-02744
02C	W70-02494	04A	W70-02576	02F	W70-02657	03C	W70-02745
06B	W70-02495	04A	W70-02577	02E	W70-02658	06G	W70-02746
02E	W70-02496	04A	W70-02578	02C	W70-02659	05C	W70-02747
02E	W70-02497	04A	W70-02579	07C	W70-02660	02A	W70-02748
02E	W70-02498	04A	W70-02580	07C	W70-02661	02K	W70-02749
02E	W70-02499	04A	W70-02581	07C	W70-02662	08E	W70-02750
02H	W70-02500	04A	W70-02582	07C	W70-02663	08E	W70-02751
06E	W70-02502	04A	W70-02583	07C	W70-02664	05G	W70-02752
02K	W70-02503	06E	W70-02584	07C	W70-02665	05C	W70-02753
05B	W70-02504	06E	W70-02585	07C	W70-02666	05G	W70-02754
02K	W70-02505	06E	W70-02586	04A	W70-02667	05F	W70-02755
05B	W70-02506	03D	W70-02587	02B	W70-02668	02F	W70-02756
07B	W70-02507	04A	W70-02588	02J	W70-02669	06C	W70-02757
02H	W70-02508	06E	W70-02589	07B	W70-02670	05G	W70-02758
02H	W70-02509	06E	W70-02590	02J	W70-02671	02G	W70-02759
05C	W70-02510	06E	W70-02591	02E	W70-02672	02L	W70-02760
02H	W70-02511	06E	W70-02592	05B	W70-02673	05B	W70-02761
05G	W70-02512	05D	W70-02593	05G	W70-02674	05C	W70-02762
05G	W70-02513	05D	W70-02594	02F	W70-02675	02A	W70-02763
05G	W70-02514	05D	W70-02595	02G	W70-02676	05C	W70-02764
04A	W70-02515	05D	W70-02596	05C	W70-02677	06E	W70-02765
04A	W70-02516	05D	W70-02597	05C	W70-02678	05C	W70-02766
04C	W70-02517	06E	W70-02598	05C	W70-02679	05F	W70-02767
05G	W70-02518	06E	W70-02599	06A	W70-02680	05A	W70-02768

ACCESSION NUMBER INDEX

06E	W70-02519	05D	W70-02600	06A	W70-02681	02K	W70-02769
04A	W70-02520	05D	W70-02601	06E	W70-02682	05C	W70-02770
04D	W70-02521	05D	W70-02602	02H	W70-02683	05A	W70-02771
05F	W70-02522	05D	W70-02603	02H	W70-02684	05C	W70-02772
06E	W70-02523	05D	W70-02604	04A	W70-02685	04A	W70-02773
04A	W70-02524	05D	W70-02605	04A	W70-02686	08A	W70-02774
05A	W70-02775	05C	W70-02792	06E	W70-02809	06E	W70-02826
05A	W70-02776	05B	W70-02793	06E	W70-02810	04A	W70-02827
05A	W70-02777	05C	W70-02794	06E	W70-02811	05G	W70-02828
05A	W70-02778	05C	W70-02795	06E	W70-02812	04A	W70-02829
05A	W70-02779	05A	W70-02796	06E	W70-02813	06E	W70-02830
05C	W70-02780	05C	W70-02797	06E	W70-02814	06E	W70-02831
05C	W70-02781	02H	W70-02798	06E	W70-02815	05G	W70-02832
05A	W70-02782	02H	W70-02799	03D	W70-02816	05G	W70-02833
05C	W70-02783	02H	W70-02800	06E	W70-02817	04D	W70-02834
05C	W70-02784	05A	W70-02801	06E	W70-02818	06E	W70-02835
05G	W70-02785	05C	W70-02802	06E	W70-02819	05G	W70-02836
05A	W70-02786	05C	W70-02803	05G	W70-02820	06E	W70-02837
05B	W70-02787	05C	W70-02804	04A	W70-02821	04A	W70-02838
05C	W70-02788	06E	W70-02805	04A	W70-02822	06E	W70-02839
02H	W70-02789	06E	W70-02806	04A	W70-02823	06E	W70-02840
05C	W70-02790	06E	W70-02807	04A	W70-02824	06E	W70-02841
05C	W70-02791	06E	W70-02808	06E	W70-02825	04A	W70-02842

ABSTRACT SOURCES

Source	Accession Number *
A. Centers of Competence	
U.S. Geological Survey - Hydrology	W70-02443 -- 02499 02617 -- 02675
University of Wisconsin - Eutrophication	W70-02500 -- 02511 02775 -- 02804 02683 -- 02685
University of Florida - Eastern U.S. Water Law	W70-02512 -- 02550 02569 -- 02592 02805 -- 02842 02502, 02569, 02584, 02585, 02586, 02598, 02599, 02682, 02718, 02732, 02737
University of Arizona - Arid Land Water Resources	W70-02551 -- 02568
University of Texas - Municipal Wastewater Treatment	W70-02593 -- 02616
Vanderbilt University - Thermal Pollution	W70-02701 -- 02723 02739
Rutgers-The State University - Water Resources Economics	W70-02694 -- 02700 02733
B. Others:	
Iowa Water Resources Research Institute	W70-02676, 02759
South Carolina Water Resources Research Institute	W70-02677
Massachusetts Water Resources Research Center	W70-02678
South Dakota Water Resources Research Institute	W70-02679
Arizona Water Resources Research Center	W70-02680, 02745
New York Water Resources and Marine Sciences Center	W70-02681
U.S. Forest Service	W70-02686, 02724
Office of Saline Water	W70-02687 -- 02693 02741 -- 02743
U.S. Naval Civil Engineering Laboratory	W70-02725
Missouri Water Resources Research Center	W70-02726 -- 02728

* Numbers are generally inclusive, except for numbers not used and individual numbers listed under other entries.

ABSTRACT SOURCES

Source	Accession Number
New Mexico Water Resources Research Institute	W70-02729
Connecticut Institute of Water Resources	W70-02730 -- 02731 02735, 02747, 02749, 02756
Delaware Water Resources Center	W70-02734
California Water Resources Center	W70-02736, 02757 02763
Oak Ridge National Laboratory	W70-02740
U.S. Coast Guard	W70-02744
Virginia Water Resources Research Center	W70-02746
Washington Water Research Center	W70-02748, 02758, 02762
Rhode Island Water Resources	W70-02750 -- 02751 02753 -- 02755 02768 -- 02769 02771
Georgia Water Resources	W70-02752, 02774
North Carolina Water Resources Research Institute	W70-02760, 02764
Arkansas Water Resources Research Center	W70-02761
New Hampshire Water Resources Research Center	W70-02765, 02772
Louisiana Water Resources Research Institute	W70-02766
Illinois Water Resources Center	W70-02767
West Virginia Water Research Institute	W70-02770
Federal Water Pollution Control Administration	W70-02773

Subject Fields

- 1 NATURE OF WATER
- 2 WATER CYCLE
- 3 WATER SUPPLY AUGMENTATION AND CONSERVATION
- 4 WATER QUANTITY MANAGEMENT AND CONTROL
- 5 WATER QUALITY MANAGEMENT AND PROTECTION
- 6 WATER RESOURCES PLANNING
- 7 RESOURCES DATA
- 8 ENGINEERING WORKS
- 9 MANPOWER, GRANTS, AND FACILITIES
- 0 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

- SUBJECT INDEX
- AUTHOR INDEX
- ORGANIZATIONAL INDEX
- ACCESSION NUMBER INDEX
- ABSTRACT SOURCES

U.S. DEPARTMENT OF COMMERCE
CLEARINGHOUSE FOR FEDERAL INFORMATION
SCIENTIFIC AND TECHNICAL INFORMATION
Springfield, Va. 22151

OFFICIAL BUSINESS



POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE